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# ECONOMIC GEOGRAPHY

## JULY

CANADA'S ADVANCE TO HUDSON BAY
Harold S. Patton, *Associate Professor of Economics, University of Cincinnati*

ECONOMIC CONDITIONS IN ST. VINCENT, B. W. I.
G. Wright, *Lecturer in Economics, Imperial College of Tropical Agriculture, Trinidad*

ECONOMIC GEOGRAPHY OF THE HAWAIIAN ISLANDS
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AGRICULTURAL REGIONS OF SOUTH AMERICA
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IRON AND STEEL INDUSTRY OF THE CLEVELAND DISTRICT
John B. Appleton, *Geographer, University of Illinois*

CLARK UNIVERSITY, WORCESTER, MASSACHUSETTS, U.S.A.

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## CANADA

CANADA, one of the most progressive and prosperous states in the British Commonwealth of Nations, sets the pace for the world in pioneer occupation of new lands and development of unutilized resources. Within almost a half century she has settled and brought in to fruitful production most of her great grassland farming empire lying west of Lake Superior and Hudson Bay; developed the power, pulpwood, and other industries of Ontario, Quebec, and the Maritime provinces; discovered and exploited vast mineral deposits throughout her broad domain; and extended her roads, railways, and sea-routes from coast to coast, from the Great Lakes to Hudson Bay and the shores of the Arctic.

Canada is a land of variety in people, in history, in character of climate, soil, and relief, in resources and industries. The staid, conservative population of the French sections of Quebec, or the Scotch villages of Nova Scotia and New Brunswick constitute a striking contrast to the restless, progressive English and Americans along the Great Lakes and on the western prairies; the long-established customs and culture of Halifax and Montreal founded centuries ago are at striking variance with the glaring newness and primitiveness of Edmonton and The Pas, founded a decade or so ago; the hardwood plains of southern Ontario are quite unlike the spruce- and fir-grown valleys of the Laurentian plateau or the lodgepole pine slopes of the Canadian Rockies. The fishing fleets off the Nova Scotia banks; the ranks of reapers and combines in the Manitoba wheat fields; the power plants and pulp mills of the St. Maurice rapids; the stampmills and concentrators at the mines of Ontario and British Columbia; the fur factories of Keewatin; the superbly appointed trains of the transcontinental railways, and the commodious steamers that dock at Vancouver and Montreal; all these indicate the diversity of the Dominion's resources.

Such an empire of potential peace and power and prosperity! Such a bulwark of culture and civilization! Such a star in the brilliant galaxy of American nations! Such a land of golden opportunity!—is Canada.

ECONOMIC GEOGRAPHY

VOL. 5 JULY, 1929 No. 3

# CANADA'S ADVANCE TO HUDSON BAY

*Harold S. Patton*

Associate Professor of Economics, University of Cincinnati

IN the historic penetration of the upper half of the North American continent there were two maritime gateways through which explorers, traders, and colonizers from Western Europe gained entrance. The more accessible portal, and the one controlled by France for over two hundred years, was the St. Lawrence Gulf and River. The more northerly entry was the icy strait and inland sea into which Henry Hudson, in his quest for the North-West Passage, penetrated—but from which he never emerged—the year after he had discovered, on behalf of the Dutch, the river at whose mouth the metropolis of the New World was to arise. Hudson's name is thus associated with the busiest, and also with the least trafficked, waterway of the eastern coast of America. The subsequent voyage made into Hudson's sea in 1668, under the patronage of Prince Rupert of England, by the two French fur-trading adventurers, Radisson and Groseilliers (who had earlier reached James Bay overland from Canada), marked the beginning of British commercial activity and political control in the future Dominion of Canada. Ever since 1670, when Charles II granted his spacious charter to "the Governor and Company of Adventurers of England Trading into Hudson's Bay," the ships of the Great Company, with its famous motto, "Pro Pelle Cutem" ("skin for skin"), have pursued their trading voyages to and from Rupert's Land, through the only North-West Passage that has ever proved of any commercial significance.

## HUDSON BAY IN CANADIAN HISTORY

During the French régime in Canadian history, England's proprietorship over Hudson's sea and its coasts was frequently challenged, and in the days of William of Orange and Queen Anne more than one naval encounter was fought in the icy waters where Hudson and his little son had perished. Even after France had lost Canada to Britain in the Seven Years' War the northern struggle was renewed. In the year before England recognized the independence of her American colonies, La Pèrouse's squadron entered the Bay and captured the Company's powerful Fort Prince of Wales at the mouth of the Churchill River, where the terminal of the Hudson Bay Railway is now being constructed. Under the Peace of Versailles, however, the Company's North American Gibraltar was restored.

Even in the chartered days of the Company the importance of Hudson Bay was not exclusively identified with the fur trade and whale fisheries. Through this northerly gateway, indeed, the pioneers of the first

FIGURE 1.—Major physiographic regions of North America. The Laurentian Upland, variously known as the pre-Cambrian, Archean or Canadian Shield, comprises an area of approximately 2,000,000 square miles, completely surrounding Hudson Bay, and occupying the major portion of Central and Eastern Canada, as well as the mineralized region of Northern Minnesota, Wisconsin, and Michigan. The central part of the United States, in contrast, is occupied mainly by the vast interior plain. The penetration and development of the Laurentian hinterland, so long an economic as well as geographic barrier between old Ontario and Quebec and the Canadian Northwest, has attained the proportions of a national movement in post-war Canada. (Map from "Canada as a National Property," Dept. of Interior, Ottawa.)

agricultural settlement in Western Canada made their entry. It was in 1811 that Lord Selkirk, the philanthropic and imperial-minded Scottish nobleman, who had recently acquired a controlling interest in the Hudson's Bay Company, sent out his first contingent of Highland settlers. After wintering and building boats at York Factory, the party of seventy Selkirk colonists made the arduous boat journey up the Hayes River into Lake Winnipeg and thence to the Red River at its lower end, where within the next three years they were joined by 200 more Scottish immigrants following the same water route. Despite the devastating visitations of frost, flood, and grasshoppers in the early years, and despite the violent opposition of the North-West Company, culminating in the Seven Oaks Massacre of 1816, grain growing has been carried on continuously in the fertile lower Red River Valley ever since 1812. The families of the original Selkirk colonists were supplemented by retired Hudson Bay servants—chiefly Orkneymen, and by French-Canadian half breeds, thus merging the native Indian, the French, and the British elements of Canada's racial stocks. It is not generally realized that a substantial, well-ordered agricultural community existed in the very center of the North American continent before the westward trek into Ohio reached its crest, and that a God-fearing settlement had been established near the site of the present city of Winnipeg before Chicago had become known even as a fur-trading post.

For nearly half a century the contacts of the Red River settlers with the Old Land were maintained by the annual voyages of the Hudson's Bay Company ships, one of which came to York Factory at the mouth of the Hayes River, and the other to Fort Albany on James Bay. Harriet Sinclair, who died in Winnipeg shortly after the Great War, has related to the author of "Women of Red River," how when her husband, a medical officer in the Company's service, was transferred from Fort Garry (Winnipeg) to Fort Albany, their heavy household goods were taken in York boats, up Lake Winnipeg and down the Hayes to York Factory, and there loaded on to the Company's ship sailing for London,

from which they were brought to their destination the following summer in the Hudson's Bay schooner from the Thames to Fort Albany!

As the Louisiana Purchase followed the federal unification of the revolutionary American states, so the Confederation in 1867 of the British North American colonies of Upper and Lower Canada (Ontario and Quebec), Nova Scotia, and New Brunswick, had as its sequel the acquisition, two years later, of the vast Hudson's Bay Territory by the new Dominion of Canada. In return for £300,000—a sum equivalent to two-fifths of one per cent of the value of Western Canada's wheat exports last year—the Hudson's Bay Company surrendered its territorial rights over Prince Rupert's Land (that is, all the land draining into Hudson Bay), being allowed to retain, however, its forts and trading privileges, and one-twentieth of all the land thereafter surveyed for settlement, lying south of the North Saskatchewan River between the Rockies and Lake Winnipeg. Out of the southeastern portion of Canada's "Louisana Purchase," there was created in the following year the Province of Manitoba, with the Red River Settlement as its nucleus.

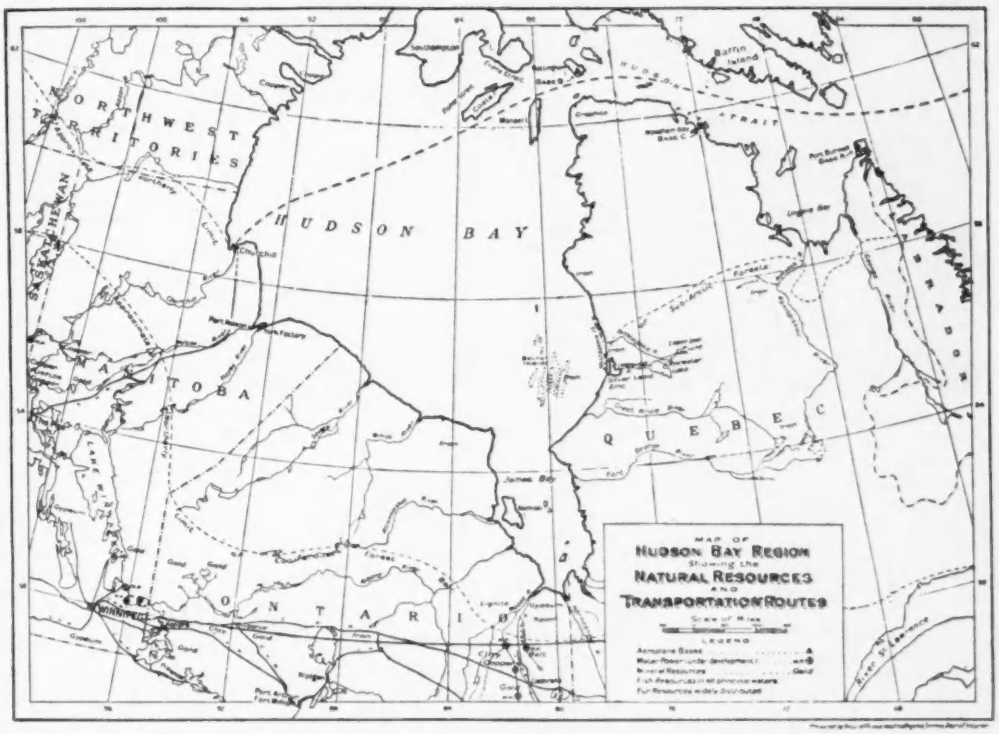


FIGURE 2.—Prospecting and mining of precious and base metals is being actively carried on at present through the Canadian Shield from the Saskatchewan-Manitoba boundary on the west to the region north of Lake St. John in Quebec on the east. The Hudson Bay Railway from The Pas to Fort Churchill is 511 miles in length. From Saskatoon in the western grain belt to Liverpool the shipping distance by way of Churchill and Hudson Strait is about 1,300 miles less than via the Great Lakes, Montreal and Cape Race. (Map from "The Hudson Bay Region," Dept. of Interior, Ottawa, 1929.)

FIGURE 3.—Aerial view of The Pas on the Saskatchewan River, starting point of the Hudson Bay Railway. The Pas is important as a lumbering and fur trade center, and as the base for prospecting and mining operations in the northern Manitoba Mineral Belt. During 1928 an 88-mile branch line was completed from The Pas to the Flin-Flon copper-zinc-gold mining camp. (Courtesy of Royal Canadian Air Force.)

## BARRIERS TO CANADIAN UNIFICATION

Between the fledgling Prairie Province and the settled portion of the eastern provinces, there intervened a thousand miles of rocky, Laurentian wilderness. The fur-traders of the North-West Company (amalgamated in 1821 with the Hudson's Bay Company after decades of mutually destructive conflict) had penetrated the North-West from Eastern Canada, by voyaging up the Great Lakes to Fort William where lay their western headquarters, thence following the water route that forms the present boundary between the Rainy River District of Ontario and the state of Minnesota, through the Lake of the Woods, and down the Winnipeg River into Lake Winnipeg, and pushing up the Saskatchewan to the foothills of the Rockies and the Mackenzie Basin. After the Hudson Bay Purchase the Dominion Government cut through the amphibious Dawson Road, connecting the more navigable waterways of the fur-traders' route from Thunder Bay to the Red River, but during the sixties and seventies the principally used means of access to the Manitoba country was by way of Minnesota, first by ox-train, stage coach, or steamer down the Red River Valley, and later by the Government-built Red River Railway, connecting at Pembina on the border with James Hill's St. Paul and Pacific line. It was not until the completion to Winnipeg in 1883 of the Canadian Pacific Railway, in execution of the confederation pact with British Colum-

FIGURE 4.—Fisher Avenue, The Pas, Manitoba, in winter. (Courtesy of Natural Resources Intelligence Service, Canada.)

bia for a transcontinental railway, that a practicable all-Canadian highway existed between the North-West and Eastern Canada, and that the export of prairie-grown grain became a commercial possibility.

### THE PRE-WAR RAILWAY BOOM

The period from the turn of the century—by which time the desirable free land of the American North-West had become fairly completely absorbed—until the outbreak of the Great War, marked the boom era of Canada's westward expansion. The Canadian Pacific had laid out its course over the Prairies within tapping distance of Hill's Great Northern Railway, and earlier settlement had strung out as an irregular fringe paralleling the American border. As immigration poured into the Prairies in waves that reached their crest just before the World War, homesteaders spread out northwards as well as westward, occupying the fertile lands between the South and North Saskatchewan rivers. Amid these booming conditions two new transcontinental railways sprang into existence, giving Western Canada a measure of economic breadth as well as length, and offering more northerly routes for settlement and grain transport. One of these roads, the Canadian Northern, opened up the fertile North Saskatchewan valley to Edmonton, and provided a new grain outlet to the Head of the Lakes, paralleling the North-West Company's old water route. The second system, the National Transcontinental-Grand Trunk Pacific, represented the execution of Sir Wilfred Laurier's grandiose project of a great northern transcontinental route, which should open up the Laurentian hinterland of Quebec and Ontario, by a government-built air-line railway between Quebec City and Winnipeg, to be operated by the Grand Trunk Pacific, whose western main line

stretched from Winnipeg to Edmonton, and thence through the Yellowhead Pass of the Rockies and the valleys of Central British Columbia to the new North Pacific port of Prince Rupert, just below the extremity of the Alaskan panhandle. Concurrent government aid given to the Canadian Northern in expanding its prairie system into a third transcontinental, reaching westward to Vancouver, and eastward to the St. Lawrence through the Superior wilderness, between the Canadian Pacific Railway and National Transcontinental lines, constituted an unwarranted duplication of non-traffic producing railway mileage, and involved the Dominion in financial commitments, which under the stress of wartime embarrassments, eventually necessitated the taking over of both new transcontinentals by the Federal Government and their consolidation into the Canadian National Railways.

The pre-war decade was marked not merely by the construction of the two northerly transcontinental lines, but also by the springing up of new longitudinal roads to the north, in the optimistic effort to extend Canada's economic frontiers in the direction of Hudson Bay. In Manitoba the Canadian Northern was pushed to The Pas, where the Saskatchewan swings southward to reach Lake Winnipeg. From this point the Federal Government was led under strong western pressure to undertake the building of a line to Hudson Bay. In Ontario the Temiskaming and Northern Ontario and the Algoma Central and Hudson Bay Railroads struck north through the Laurentian country from Lake Nipissing and Sault Ste. Marie respectively. The

FIGURE 5.—Bowden, Manitoba, on the Hudson Bay Railway, mile 130. At this point the railway enters the clay belt of northern Manitoba, whose soils were deposited as beds of old lakes and are well suited to mixed farming. (Courtesy of Royal Canadian Air Force.)

story of these last three roads marks a new phase in the significance of Hudson Bay in Canada's history.

*The Temiskaming and Northern Ontario Railway*

Although Ontario is the most populous and highly industrialized province of the Dominion, most of its people and economic activity, prior to 1903, were confined to the comparatively small fraction of its area, which lies between the Lower Lakes and the Ottawa Valley—in other words, to that portion of Canada which dips below the line of the 49th parallel. With a view to retaining within its own spacious borders some of the overflow of its population into Western Canada and the United States, the province of Ontario in 1902 authorized the construction of a government colonization and development railroad, northward from North Bay at the eastern end of Lake Nipissing, towards the fertile Clay Belt, lying beyond the watershed between Lake Huron and James Bay. The probable discovery of "ore and minerals which would greatly add to the wealth of the province" was forecast in the preamble of the bill, as an additional justification of the project. The initial speculations, however, have been far exceeded by the actual disclosures and subsequent development. As the building of the Canadian Pacific Railway north of the Upper Lakes resulted in the accidental exposure in 1883 of the famous nickel-copper deposits of the Sudbury mineral basin, so the pickwork of the construction gangs on the Temiskaming and Northern Ontario led in 1903 to the uncovering of sensational silver nuggets. Out of this unsuspected discovery sprang the notable Cobalt mining camp, out of which over 350,000,000 ounces of silver have been recovered to date. Even more sensational was the discovery, six years later, to the northwest of Cobalt, of auriferous outcroppings in the pre-Cambrian quartz of the porcupine field, which, with its Dome, Hollinger and McIntyre mines, now ranks second only to the South African Rand, as the world's greatest gold-producing camp. By 1911 a branch line had been pushed through to this field, while some half dozen other productive branches have been extended to

FIGURE 6.—Scenes on the Horn Copper Corporation of Noranda Mines property adjacent to Rouyn, the important gold-copper area of Northwestern Quebec. A townsite is being laid out on this land and it is intended to make it a model community. Rouyn is now served by two railways—a branch line from the National Transcontinental at Taschereau and the Nipissing Central Extension of the Temiskaming and Northern Ontario Railway. (Courtesy of Canadian National Railways.)

tap other adjacent mineral fields. The Kirkland Lake branch has recently been extended under the charter of the Nipissing Central, across the Quebec border into the Rouyn district where the proved copper-gold deposits of the pioneer Horne Mine, and new discoveries of almost fortnightly occurrence over a widening range, have justified the installation of the huge Noranda smelter to which hydro-electric power has been brought over 100 miles from the Upper Ottawa. The Temiskaming and Northern Ontario is one of the world's most important mining railroads. Gold discoveries have been recorded in no less than 110 townships along its route and within a comparatively few years dividends aggregating $190,000,000 have been distributed by the precious metals interests served by its lines. It is estimated that about one-third of the capital involved in the New Ontario mining industry is American money.

The Temiskaming and Northern Ontario Railway has also been of great value in the development of New Ontario's lumber, pulp, and paper industry, and in agricultural colonization. A spur to Iroquois Falls affords transportation facilities to one of the world's greatest newsprint mills, that of the Abitibi Pulp and Paper Company. Within half a dozen years of the first track laying out of North Bay, Ontario's government railroad had been extended to meet the National Transcontinental at Cochrane, in the heart of the Great Clay Belt lying north of the mineral zone, and extending westerly some 350 miles from within Quebec to the Algoma District of New Ontario. Thousands of homesteaders and soldier settlers have been improving bush farms along this fertile northern tract, pulpwood being their first crop, with the subsequent grain, hay, vegetables, and dairy products being mainly marketed to mining towns, pulp and paper communities, and construction camps. It is a country in which the French-Canadian settler—finest of axemen, gayest and most resourceful of backwoodsmen, and most prolific of offspring—takes vigorous root.

The Clay Belt, however, no longer marks the northern objective of Ontario's colonization railway. From Cochrane to Moose Factory at the southeastern extremity of James Bay the airline distance is but 156 miles. Extensive pulpwood reserves stretch to the northwest, the Abitibi abounds in waterpowers, with tributary gypsum, commercial clay and lignite deposits, and beyond lie the fisheries of James Bay. Proceeding on the basis of reconnaisances, geological and aerial, of the resources of the James Bay basin, and of surveys of harbor and navigation conditions on the Bay itself, the province of Ontario, since 1925, has been extending its road, step by step, beyond Cochrane, some 90 miles of the James Bay extension now being completed. Within a very few years, Ontario expects to have direct rail service with a tidewater harbor at Moose Factory.

### *The Algoma Central and Hudson Bay Railroad*

About the same time that the Temiskaming and Northern Ontario Railway was launched, another Bayward road was being thrown forward from Sault Ste. Marie, situated 260 miles to the west of North Bay. At this exit of Lake Superior there had been erected at the very end of the last century the iron, steel, and rail

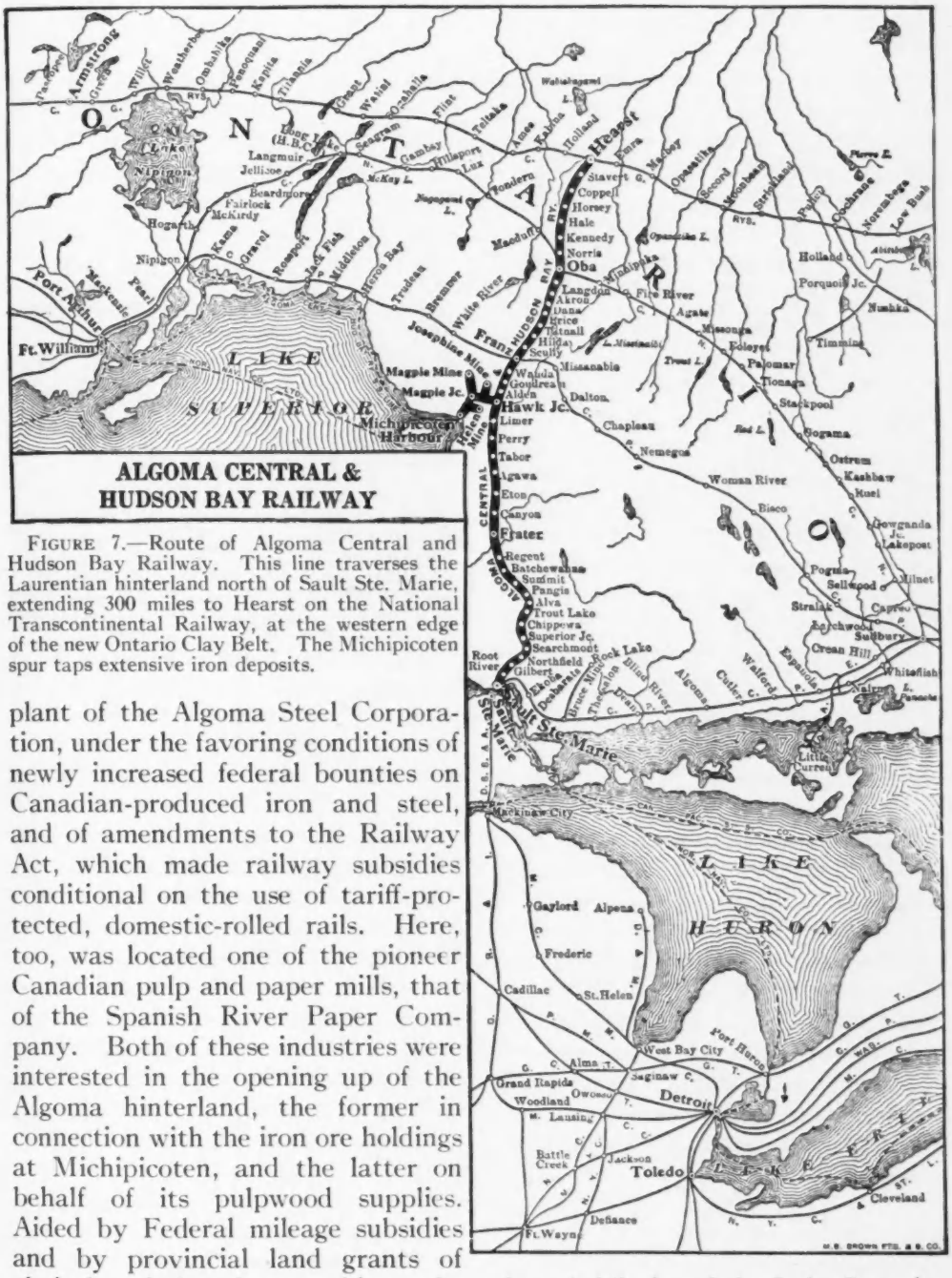


FIGURE 7.—Route of Algoma Central and Hudson Bay Railway. This line traverses the Laurentian hinterland north of Sault Ste. Marie, extending 300 miles to Hearst on the National Transcontinental Railway, at the western edge of the new Ontario Clay Belt. The Michipicoten spur taps extensive iron deposits.

plant of the Algoma Steel Corporation, under the favoring conditions of newly increased federal bounties on Canadian-produced iron and steel, and of amendments to the Railway Act, which made railway subsidies conditional on the use of tariff-protected, domestic-rolled rails. Here, too, was located one of the pioneer Canadian pulp and paper mills, that of the Spanish River Paper Company. Both of these industries were interested in the opening up of the Algoma hinterland, the former in connection with the iron ore holdings at Michipicoten, and the latter on behalf of its pulpwood supplies. Aided by Federal mileage subsidies and by provincial land grants of choicely timbered townships, the Algoma Central and Hudson Bay Railway came into existence as a privately owned development road, promoted by Soo steel and paper interests. It now constitutes one of the subsidiaries of the Lake Superior Corporation, the holding company of the Algoma Steel Corporation and other related industrial enterprises.

Bit by bit, in the years preceding the war, the Algoma Central was

pushed northward, until by 1915, at mile 296, it reached the National Transcontinental at Hearst. The first 115 miles of the road traverse a difficult, but rarely beautiful, mountainous course as it climbs up over the Superior watershed. The Agawa Canyon, whose anciently glaciated slopes are covered by luxuriant virgin forests, in which the verdure of broad-leaved and coniferous trees are gloriously blended, with lofty waterfalls spraying their foliage, and with unexpected turns revealing in the distance the stately waters of Lake Superior, led Colonel Currie, in his book, "The Red Watch," to exclaim: "The Highlands of Scotland are not so majestic as the range of the Agawa valley on the northeast coast of Lake Superior, which is probably the most beautiful spot in the whole world." While an annually increasing number of tourists are discovering that the little-known Algoma Central Railway traverses some of the boldest scenery east of the Rockies, the laborious construction of the road was undertaken for more substantial purposes than the opening up of a tourists' and sportsmen's paradise. Lumber, pulpwood, and steel constitute its bulkier freight, while within the last few years prospector's supplies and mining equipment have become increasingly important items. From a point 165 miles north of the Soo a branch line runs to Michipicoten Harbor at the northeastern corner of Lake Superior. Michipicoten is New Ontario's oldest mining division, a minor gold rush having occurred here at the time of the Klondike stampede. Gold prospecting led to the disclosure of extensive iron-ore bodies, and the Helen mine, from which 2½ million tons of hematite ore were shipped by water to the furnaces of the Algoma Steel Corporation, exceeded the production record of any Canadian iron mine. For some years, however, the Michipicoten iron mines have been inactive, the Algoma Corporation finding it cheaper under existing conditions to import the stripped

FIGURE 8.—Montreal River Falls, Algoma Central Railway, mile 91. Hydroelectric power from the Montreal River is transmitted by the Great Lakes Power Company to Sault Ste. Marie, with its pulp and paper, and iron and steel, industries. (Courtesy of Algoma Central and Hudson Bay Railway.)

hematite ore of the Misabi range in Minnesota. Recent disclosures of extensive, high-grade siderite bodies at the New Helen mine, and prospective government bounties on beneficiated domestic iron ore, are expected to lead to a resumption of production in this most promising and accessible of Canada's rather limited iron areas. In any case it is only a question of time until the approaching exhaustion of the superficial hematite ores of Minnesota, available without beneficiation, will warrant the economic exploitation of the extensive iron reserves of Algoma. In the meantime, gold has again come to the fore in the Michipicoten district, and at Goudreau to the north. Modern diamond drilling

and shaft driving by hydro-electric power from the Michipicoten River, carried on by strong capitalized syndicates, have already revealed auriferous reserves of such extent and grade as to warrant the early installation of a large-scale concentration mill by the Pioneer Mining Corporation.

From the present northern terminus of the Algoma Central at Hearst, down the Missinaibi and Moose rivers to Moose Factory on James Bay, the distance is about the same as from Cochrane down the Abitibi to the Moose estuary. Two railways to the same Bay terminus would not appear to be warranted, however, at least for some time to come. The Temiskaming and Northern Ontario, with the province of Ontario behind it, with its more productive local traffic, and with its direct connections with Toronto and Montreal, is unquestionably the line whose extension to Ontario's salt-water bay, would be more justified. The Algoma Central, however, which strikes across Canada's three transcontinental lines, constitutes a useful lateral through what is geographically almost the center of the vast province of Ontario. At the present time its revenue barely covers operating expenses, but its developing mining territory, its mounting tourist traffic, and its transcontinental connections afford the prospect of a profitable future.

### QUEBEC'S PUSH TO THE BAY

The development of Ontario's hinterland is being accompanied by a more recently initiated, but a no less promising activity, in the northwestern part of the neighboring province of Quebec. The rapid agricultural settlement of the Quebec Clay Belt and the Lake St. John region, the large-scale mining operations in the Rouyn district, the huge water power and electro-chemical developments on the upper Saguenay —where the Aluminum Company of Canada's model town of Arvida already has a population of 8,000—

FIGURE 9.—Hydroplane of Ontario Flying Service on forest fire patrol in Algoma District. The Ontario Department of Lands and Forests maintains some twenty-five machines, having their main base at Sault Ste. Marie, for fire detection and suppression in Crown timberlands and for aerial photographic surveys. Gasoline caches are maintained at remote points near James Bay and the Manitoba boundary. (Courtesy of Algoma Central and Hudson Bay Railway.)

these movements are now yielding in focal interest to the sensational prospecting activities among the gold-silver-copper ores of the Chibougamau-Doré district, lying just beyond the St. Lawrence-Hudson Bay watershed, some 300 miles due north of Montreal. A British-controlled syndicate, it is stated, has already arranged the financing for the chartered Quebec, Saguenay, and Chibougamau Railway which will pass from Chicoutimi at the head of Saguenay navigation, to the north of Lake St. John, and thence 170 miles northwest to Chibougamau. Quebec, like Ontario, has its eyes on a James Bay terminal, and at the present rate of northward expansion, it is expected that the time is not distant when Chibougamau itself will be the jumping-off point for a new bay railway,

FIGURE 10.—Kettle Rapids crossing of Nelson River by Hudson Bay Railway, 332 miles from The Pas. The decision in 1912 to make Port Nelson the Bay terminal of the railway involved the construction of two costly bridges over the Nelson, which might have been avoided if the original intention of making the more distant harbor of Fort Churchill the terminal had been adhered to. (Courtesy of Royal Canadian Air Force.)

following the broad Nottaway River down to the old Hudson Bay post at Rupert House, where probably the best natural harbor on James Bay is to be found. In the meantime the province of Quebec is carrying on a systematic aerial-photographic survey of the topography and resources of this portion of its immense domain which extends to Hudson Strait.

## WESTERN CANADA'S INTEREST IN THIS HUDSON BAY ROUTE

We must travel back to Manitoba, however, to strike Canada's major road to Hudson Bay—the Hudson Bay Railway proper. As the prewar influx of agricultural immigration into Western Canada, and the introduction of the early-maturing Marquis wheat, combined to extend the grain growing frontier steadily northward, the possibilities of utilizing Hudson Bay as a supplementary grain outlet to the frequently congested Great Lakes-St. Lawrence route, began to be seriously considered. A little figuring on the map showed that the sailing distance from Port Nelson on the Bay to Liverpool was approximately the same as from Montreal to the Mersey by the Cape Race route, while the rail haul from, say Saskatoon, to Nelson was 140 miles less than that to the Head of the Lakes. The saving of the 1,200 miles shipment by the Great Lakes route from Fort William to Montreal and attendant transfers would, it was calculated, permit a reduction of ten cents a bushel in the cost of exporting Western wheat to Liverpool. The building of a railway to Hudson Bay and the construction of grain terminals at Port Nelson or Fort Churchill became a firm plank in the political platform of the Western grain growers as far back as 1910.

At various times in the past the Federal Government had sent expeditions to investigate the naviga-

FIGURE 11.—Construction works at Port Nelson, Manitoba. Some $6,000,000 was spent during the war period in harbor construction and dredging operations at Port Nelson, work being suspended in 1918. A considerable amount of the equipment has been transferred to Fort Churchill. (Courtesy of Royal Canadian Air Force.)

tional possibilities of Hudson Strait and Bay. Commander Gordon made three voyages to the Bay in the summers of 1884–1886, and further expeditions had been dispatched in 1897 and in 1903–1904. While the reports of these navigators were not unencouraging, no economic demand for the development of such a route had hitherto arisen. Although from 1886 to 1908 the federal statutes contained a standing offer of subsidy in the form of land grants to any person or company which would undertake the construction of a railroad to Hudson Bay, it elicited no *bona fide* applications. Now under the ardent optimism of the pre-war boom era, with immigration to the West showing new yearly records, with British capital available for railroad building in apparently unlimited volume, and with the organized power of the Western grain growers a political factor to be reckoned with, the Laurier ministry gave its endorsement to the project of a government railway to the Bay. Shortly before its defeat in the "American Reciprocity Election" of 1911, contracts were let for the construction of the first 185 miles of a line starting from The Pas railhead, which lies 483 miles northwest of Winnipeg. Although Fort Churchill had been the Bay terminus contemplated by Sir Wilfrid Laurier, the succeeding Borden administration decided to carry the road to the less distant harbor of Port Nelson. While this shortened the route by some 50 miles, it involved two difficult crossings of the Nelson River. Work on the Bay railway and on Nelson harbor improvements were prosecuted simultaneously throughout the war years. By 1918, however, the demands made upon the federal treasury, not only by the extraordinary expenditures of the war, but also by the embarrassments of the Canadian Northern and the Grand Trunk Pacific, whose bonds the Government had so lightly guaranteed, reached such a point that the work on the Bay railway had to

be suspended, with steel laid to within 90 miles of Nelson. In addition to some $14,000,000 expended on grading, track laying, and bridge building on the road itself, an additional $6,000,000 had been sunk in dredging operations and in the construction of an artificial crib-work island and a 3,500-foot approach bridge in the Nelson roadstead.

### THE PERIOD OF SUSPENSION

The period of enforced suspension, under the post-war financial exigencies of the Government, afforded the occasion for a more sober, if belated, reconsideration of the Bay project. A special committee of the Senate was appointed in 1920 to conduct hearings with a view to reporting on "the navigability and fishery resources of Hudson Bay and Strait, and on the character of the ports of the said Hudson Bay in regard to their fitness as railway terminals." A large number of authoritative witnesses were examined, on the basis of whose somewhat conflicting evidence the Senate Committee in reporting expressed its faith in the physical feasibility and eventual profitableness of the Hudson Bay route, stating that the season of safe navigation under existing conditions appeared to be at least four months. It expressed the opinion, however, that the Government had not exercised sufficient care in the selection of Nelson as a Bay terminal, and recommended that no additional expenditures should be undertaken without a thorough examination of the relative merits of Fort Churchill and Port Nelson. While the former lay over 100 miles further north than the latter, it was known to possess a much superior natural harbor.

Meanwhile the Western Progressive Party maintained spirited pressure upon the Federal Government to complete the Hudson Bay Railway urging the prospective advantages to grain growers and livestock shippers, and denouncing "the false economy" of allowing a $20,000,000 work to go to ruin, when the investment of a few million more would make it a going enterprise. The disclosure of high-grade gold and copper-zinc deposits north of The Pas, and the opening up of mining camps at Flin Flon, Herb Lake, and other points near the operating end of the railway, were now awakening rosy hopes in the grain metropolis of Winnipeg, of an active metal-mining industry in the hinterland of what had hitherto been an exclusively agricultural province. An "On to the Bay Association" arose, boomed by the boards of trade of Winnipeg and the towns of eastern Saskatchewan. With the Western Progressives holding the balance of parliamentary power, both Liberal and Conservative parties committed themselves to the speedy completion of the Bay railway in the tense elections of 1925 and 1926. When the latter contest resulted in the firm seating of the Liberal administration of Mackenzie King, an appropriation of $5,130,000 was passed in the first session of the new Parliament for the reconditioning and completion of the Bay railway and terminal. It was announced, however, by the Minister of Railways and Canals that the extension of the line would be governed by the results of a re-examination of the question of the most suitable terminal port.

### CHURCHILL CHOSEN BAY TERMINAL

With a view to securing a thoroughly disinterested judgment on

the relative merits of Nelson and Churchill, the noted English harbor engineer, Frederick Palmer, was engaged to investigate the situation. After a visit to the Bay Mr. Palmer made an unequivocal recommendation in favor of the selection of Fort Churchill. Whereas Port Nelson lay on an open roadstead, with a treacherous entrance, passable only at high tide, over a difficult bar, Churchill possessed a completely landlocked harbor, sheltered from every wind. Furthermore, whereas the shifting channel of the Nelson estuary was bordered by miles of tidal flats, involving a prodigious and continuing amount of dredging, and huge additional expenditures on the abandoned artificial island-berths, Churchill Bay possessed a deep, narrow entrance, passable at all stages of the tide, with an area of 140 acres inside the entrance, showing depths mostly over 30 feet. Above this, relatively light dredging operations would permit extension of 30-foot anchorage to meet all conceivable future port requirements. On the other hand the selection of Churchill meant the construction of some 90 more miles of railway than would be necessary to reach Nelson. Since the availability of the Hudson Bay Railway as an export route, however, was dependent on the provision of adequate terminal facilities, the question of comparative cost and time of waiting necessarily involved the work of port as well as road construction. Mr. Palmer estimated, however, that the costs of providing corresponding harbor accommodation would be three times as great in the case of Nelson as of Churchill, and that the former would take twice as long to complete. Even allowing for the additional cost of railway construction, the total expenditure on the Churchill route would be only

FIGURE 12.—S. S. *Canadian Trooper* leaving harbor of Fort Churchill, Manitoba. Ruins of Hudson's Bay Company's Fort Prince of Wales in background. Churchill possesses a sheltered, landlocked harbor passable at all stages of the tide, and affording berthing and anchorage accommodation for ocean-going vessels with a minimum of dredging. The distance from Churchill to Liverpool is 2,936 nautical miles, compared with 2,760 miles from Montreal (via Belle Isle) and 3,036 miles from New York. (Courtesy of Natural Resources Intelligence Service, Canada.)

half as great as required at Nelson. On the basis of this convincing report, the Government announced that the road would be built to Churchill, and as much as possible of the Nelson equipment would be salvaged and transferred. While over eagerness to reach the Bay by the shortest possible route, and the reckless optimism of the pre-war railway frenzy, had involved the country in a costly blunder, the enforced suspension of operations after 1918 had been a blessing in disguise, by imposing a reconsideration of the terminal question before further millions had been wasted.

FIGURE 13.—Holt two-ton snow tractor, hauling timber near Airhole River, Churchill Harbor. Steel laid on frozen ground reached Churchill on March 29, 1929, permitting the rushing forward of equipment to the terminal before the spring thaw. Grading and permanent track laying on the Churchill section is now being completed, and it is expected that regular train service will be available in 1930. (Courtesy of Natural Resources Intelligence Service, Canada.)

During the past two years the work of reconditioning and new construction has been proceeding apace. From a point on the old route, 70 miles short of Nelson, grading has been completed and a considerable amount of track laid over the 150 mile right of way to Churchill, into which through trains will be running, it is anticipated, by 1930. The construction work is being taken care of by the Engineering Department of the Canadian National Railways to which the line will be turned over for operation. The capital expenditures on the railway and on Churchill harbor development, which it is anticipated will total $28,500,000 when completed, have been covered by budget appropriations of the Department of Railways and Canals. Against these outlays the public treasury has received some $20,000,000 from the sale of Western public lands, which under legislation in force from 1908 to 1918, were authorized to be used for the purpose of financing a railway to Hudson Bay.

The greatest difficulty of the engineers has been the battle with the muskeg. For over a hundred miles in from the Bay the frozen clayey or gravelly subsoil is covered by a spongey moss of a foot or two in depth. Since the frozen subsoil defies the use of steam shovels, fills and embankments have had to be made by dumping barrowloads of soggy, superficial muskeg removals. At the same time the frozen ground from which the oozey moss has been stripped, thaws downward under exposure to the lingering summer sun, resulting in frequent roadbed subsidence and shifting. Most of the muskeg section of the old road had to be regraded, and the rusty, twisted rails and rotting ties replaced, and much labor had to be expended in ditching and draining. Over some of the deeper swampy places carloads of poles have been placed herringbone fashion, to form a corduroy foundation for the rails.

Commencing with the summer of 1928, harbor work has been actively pushed at Churchill. The wharves are being built on the more sheltered eastern side of the estuary opposite the point where the impressive ruins of old Fort Prince of Wales still stand. Some 13,000 tons of equipment and material were moved last summer from Nelson to Churchill, the work being speeded up by two seaplanes making two round flights daily, which carried much of the lighter equipment, as well as 116 workmen. Two large dredges were towed to the harbor from Montreal, while a shipload of 3,000,000 feet of crib lumber was sent from the British Columbia coast by way of the Panama Canal and Hudson Strait, a voyage of 9,000 miles. Engineers, wireless operators, and some hundreds of workmen have added their numbers to the Hudson Bay Company employees, Mounted Police and Eskimo, who for so long constituted the sole population of Fort Churchill. A real estate boom—of whose consequences Western Canada has had too many sad experiences—has been precluded by the Government's announcement that the entire townsite of Churchill had been withdrawn from entry, and that lots would be available only through governmental lease.

### THE HUDSON STRAIT PATROL

The real physical problem of the Hudson Bay route lies less in carrying steel to a suitable port on the Bay, than in the navigability of Hudson Strait. This seaway extends some 500 miles, ranging in width from 40 miles at the entrance and exit to as much as 200 miles at Ungava Bay. Strong tidal currents prevent its freezing over entirely, but even in the summer the Strait is frequently filled with floating ice coming into the upper part of the Bay from the eastern Arctic through Fox Channel, and passing out to the north Atlantic between Ungava and Baffin Land. The ice hazard is greatly aggravated by the heavy fogs, generated by the contact of the bergs and floes with the warming waters of the Strait. Although the records of the Hudson's Bay Company reveal that "in the course of a century and three quarters, 750 vessels, ranging from 70-gun ships to 10-ton pinnaces, have passed through the Strait in the Company's service with the loss of only two ships," the economic feasibility of the route is obviously dependent on the duration of the navigation season and the cost of marine insurance. Opinions as to the period of practi-

cable navigation given by witnesses before the Senate Committee in 1920 ranged from 12 weeks to 22 weeks, all agreeing that their estimates were subject to marked seasonal variations.

With a view to procuring more continuous and comprehensive data than could be obtained from the restricted observations of occasional navigators, and to ascertaining what means might be employed to reduce marine risks, the Dominion Government determined to use the latest instrumentalities of science, by establishing aerial observation patrols in the Strait. During the summer of 1927 nine Fokker seaplanes were taken north and distributed among three patrol stations, one at Fort Burwell, at the Atlantic entrance to the Strait, the second at Wakeham Bay, Ungava, near the center of the seaway, and the third at Nottingham Island at the Bay entrance. From these bases overlapping triangular observation and photographic flights were made over the Strait whenever weather and visibility conditions permitted, daily reports being wirelessed to Hydrographic Survey headquarters at Ottawa. The interim report issued from Ottawa last year indicated that at Nottingham Island no ice was observed after August 6, and that the first ice seen in the autumn was on November 16. Not until the end of December did the ice formation become so general as to leave no definite open water lead. Observation flights were continued throughout a period of fourteen months, the expedition being brought

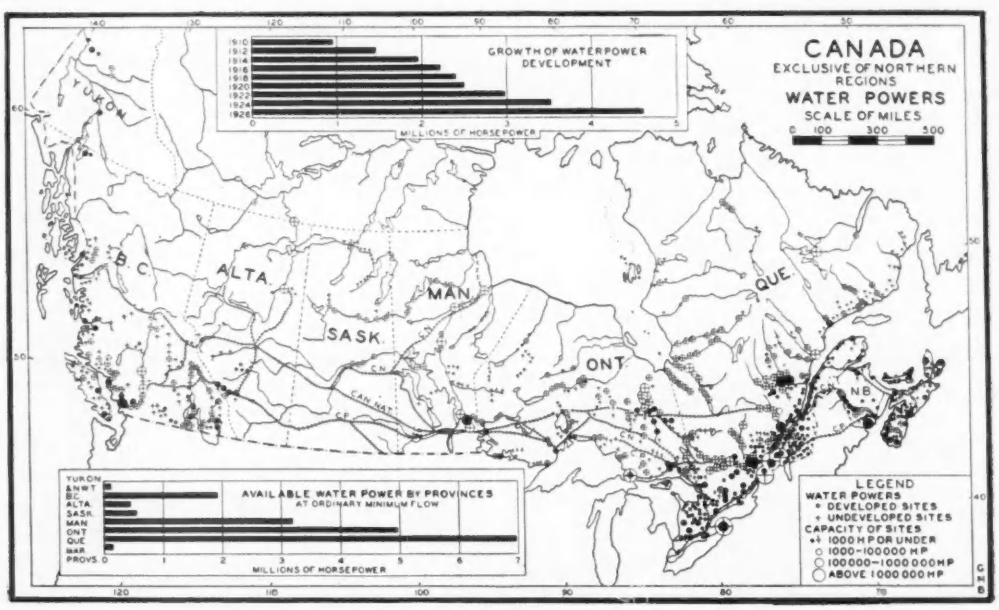


FIGURE 14.—Distribution of Canadian water power resources. The rugged, glaciated character of the Laurentian plateau provides rivers with well-defined rock banks and innumerable falls and rapids, while its ubiquitous lakes constitute natural reservoirs. In the drainage area directly tributary to Hudson Bay and James Bay, the estimated horsepower available for six months of the year is nearly nine million h.p. Of these water-power resources about one-half is provided by the Nelson River. Steps are at present being taken to develop power at Island Falls on the Churchill River for transmission to Flin-Flon, to be used in open pit mining with electric power shovels, and in the flotation mill, copper smelter and electrolytic zinc plant of the Hudson Bay Mining and Smelting Company. (Map from "Canada as a National Property," Dept. of Interior, Ottawa.)

out last September. Upon the basis of these extended observations the Department of Marine and Fisheries is laying out its program for installing navigational aids. It has already under construction in the Strait a chain of five permanent radio direction-finding and weather-reporting stations, while the more powerful station at Churchill will provide for the whole expanse of the Bay itself. Transmitters at these stations will enable ships equipped with radio to obtain bearings and directions for pursuing a safe course even in periods of heavy fog and ice-drift, and it is confidently expected that with the aid of these new devices, and with the use of ice-breakers, marine hazards can be greatly reduced, and the period of effective navigation appreciably extended.

### THE HUDSON BAY GRAIN ROUTE

While the provision of physical facilities on the Hudson Bay route is now so far advanced as to give ground for the expectation that it will be possible to handle grain shipments through Churchill by 1930, the economic practicability of the route is a less assured matter. Opponents and critics of the project discount the manifest saving in distance over the Great Lakes route, by calling attention to the restricted period of navigation, the higher marine insurance rates (government vessels were asked in 1914 to pay an 11 per cent premium), the necessity for specially constructed vessels, and the doubtful availability of incoming cargoes. They point out also that ordinarily only about 12 to 15 per cent of Canada's annual wheat exports are shipped out during the two months following harvest, and that with navigation in Hudson Strait not generally practicable after October, grain uncleared from Churchill elevators by such time would have to be carried over until the following July or August. Furthermore, the new westward grain route by the ice-free port of Vancouver and the Panama is attracting larger shipments every year, and doing much to relieve the congestion at the Head of the Lakes. More may be expected, it is claimed, in the way of reducing shipping costs, by deepening the St. Lawrence ship channel, than by seeking to divert grain export over a hazardous northern route, far removed from the main channels of commerce.

At best the Hudson Bay route is not likely to attract extensive grain export shipments except from the northeastern portion of the Prairie Wheat Belt, and then only as a supplementary outlet. As in the case of the Panama Canal, however, it is only by actual trial under competitive working conditions that the traffic-drawing merits of the waterway can be definitely demonstrated. The economic possibilities of the Hudson Bay Railway are not limited, however, to its serviceability as a grain route. Some of the best hay and fodder lands of Western Canada lie in the northern Manitoba clay belt, between the lower Saskatchewan, and the upper Nelson and Churchill rivers, and the prospect of shipping cattle on the hoof to the British Isles, by the shorter and cooler Bay route, reducing to a minimum the cost of feeding and shrinkage in transit, is by no means a fanciful one.

### RESOURCES OF THE BAY TERRITORY

Other resources may be expected to contribute their traffic. Consider-

able evidence was gathered by the Senate Committee regarding the fertile fisheries of Canada's inland sea. "Most of the Hudson Bay fish," says the report, "are believed to be freshwater fish which have adapted themselves to salt water conditions, although continuing to run up the rivers periodically to spawn." The principal commercial varieties include whitefish, tulibee, charr salmon, and ling—a member of the cod family. While the remoteness of the Bay fisheries, and navigation hazards in the Strait during the best fishing season, do not offer inducements for fishing vessels to enter the Bay from the Atlantic, a developing shore fishing industry off the river mouths by resident fishermen is likely to be a by-product of the extension of railway facilities to Churchill and Moose Factory. Vihljalmur Stefansson greatly impressed the Senate Committee, as he has most readers of "The Friendly Arctic," with the meat-producing possibilities of Canada's sub-Arctic pastures—as he prefers to call the Barren Lands of the maps. The Department of the Interior, in fact, is carrying on at the present time surveys of the feeding grounds and migratory movements of the musk-oxen and caribou between the Bay and the Arctic, and of the regions most suitable for the introduction of reindeer herds from Alaska. In view of the continued shrinkage of the available grazing lands of the temperate zones, and in view of the steadily rising cost of meat, it is by no means fantastic to contemplate the future establishment of a sub-Arctic meat packing industry at Churchill.

FIGURE 15.—Town planning in the Laurentian wilderness. Pine Falls Settlement, with pulp mill on the Winnipeg River, eastern Manitoba.

Some optimists look forward to the time when the Hudson Bay route will be used as a short cut from Western Europe to the Orient. They point out that whereas the distance between London and Yokohama via Suez is 12,000 miles, and by New York and San Francisco about 11,000 miles, the northern route by way of Churchill and Prince Rupert is but 8,000 miles. Apart altogether, how-

ever, from the use of the Hudson Bay sea-route, the construction of the Bay railway, like that of the Temiskaming and Northern Ontario, is bound to have a far-reaching influence on the internal development of the country which it traverses, through the exploitation of the mineral areas, forests, and waterpowers of the northwestern portion of the pre-Cambrian Shield. Steel has already been laid over the 86 miles between The Pas and the famous Flin Flon mine on the Manitoba-Saskatchewan boundary. On this property, now controlled by the Whitney interests of New York, some 20 million tons of copper-zinc-gold ore have already been blocked out, and a flotation mill with cyanide annex, copper smelter, and electrolytic zinc plant, capable of treating some 3,000 tons of ore a day, are now in process of installation, to which hydro-electric power will soon be brought from Island Falls on the Churchill River. An offshoot from the Flin Flon railway is now being constructed some 40 miles northeastward to reach the Sherritt-Gordon property on Cold Lake, where one of the largest copper-zinc deposits, yet disclosed, awaits exploitation. Prospecting, diamond drilling, and shaft sinking is now being carried on over a wide area between the Nelson and Churchill rivers, hydroplanes being extensively used in the transport of exploratory parties and drilling equipment. Electro-metallurgical treatment of these newly exposed ore bodies is rendered feasible by the abundance of accessible waterpowers. Surveys made by the Department of Interior indicate that some 2,500,000 horsepower can be developed at ordinary minimum flow from the Nelson River alone, with an additional 600,000 horsepower available from the Churchill.

Canada's push to Hudson Bay is in many ways an act of faith. The economic justification of the railway and harbor expenditures cannot be definitely estimated in advance. Only time can show what wealth and traffic they will make available, and what changes in transportation currents they will induce. But as an expression of Canada's confidence in the resources of her hitherto empty northland, as the evidence of a lusty nationhood that is no longer content to hug the borders of her older and wealthier neighbor, and as the manifestation of a twentieth-century frontier spirit, in which science and capital go hand in hand with pioneering hardihood, Canada's advance to Hudson Bay constitutes a new and highly significant chapter in North American economic history. The great inland sea into which Hudson broke in his search for the North-West Passage, over which the adventurers of England wielded a monopoly dedicated to the fur trade, and through which the first white settlers made their way to the Western prairies, is now in process of becoming the commercial seaboard of Canada's awakening northland.

# ECONOMIC CONDITIONS IN ST. VINCENT, B. W. I.

*G. Wright*

Lecturer in Economics, Imperial College of Tropical Agriculture

ST. VINCENT has at least four points of interest to the economic geographer—Sea Island cotton, arrowroot, the small scale cane syrup industry, and the land settlement scheme. At one time the prosperity of the island was intimately bound up with sugar production, but a succession of adverse circumstances of which the destructive competition of bounty-fed European beet sugar proved the climax terminated the importance of that industry. The Imperial Department of Agriculture for the West Indies helped the reintroduced Sea Island cotton into the British West Indies. The islands at present have practically a monopoly of the finer grades of this variety and St. Vincent is one of the principal producing centers. The economic rehabilitation of the island is largely due to this crop, now the most valuable export.

The island has long produced arrowroot but with variable success. The island is now the principal source of supply and the product takes second place among the exports.

## Position and Area

St. Vincent (13° 10′ N., 60° 57′ W., 30 miles to the southwest of St. Lucia and 97 miles west of Barbados) is 18 miles in length and 11 in width at its broadest part. It has an area of 83,115 acres, being about half the size of Middlesex.

Most of the Grenadines—a chain of islands lying between Grenada and St. Vincent and having a total area of 10,872 acres—are dependencies.

## Topography

The island is one of the lesser Antilles, a chain of volcanic islands, which form a loop from Porto Rico to Trinidad. A backbone of thickly wooded mountains extends north and south through the island. At the northern end of the range is the Soufriere, a volcano, some 4,000 feet high. The southernmost point is Mount St. Andrew, 2,600 feet high, which dominates the Kingstown Valley. Branch spurs from either side of this range break the land up into a series of transverse valleys. On the northeast side lies a more level tract of country called the Carib country, formerly the most fertile sugar producing tract of the island, until all cultivation was destroyed by the volcanic eruption of the Soufriere in May, 1902. A portion subsequently put under coconuts has become the most important coconut area.

## Climate

In general the climate is the hot moist equatorial type modified by insularity. Abundant rainfall falls chiefly in summer when the belt of convectional rains has swung northward, but on the windward slopes of the highlands moisture condenses from the northeast trades in winter also. Temperature varies from 60° F. to 88° F. Rainfall records collected at the Botanic Gardens from 1894 to

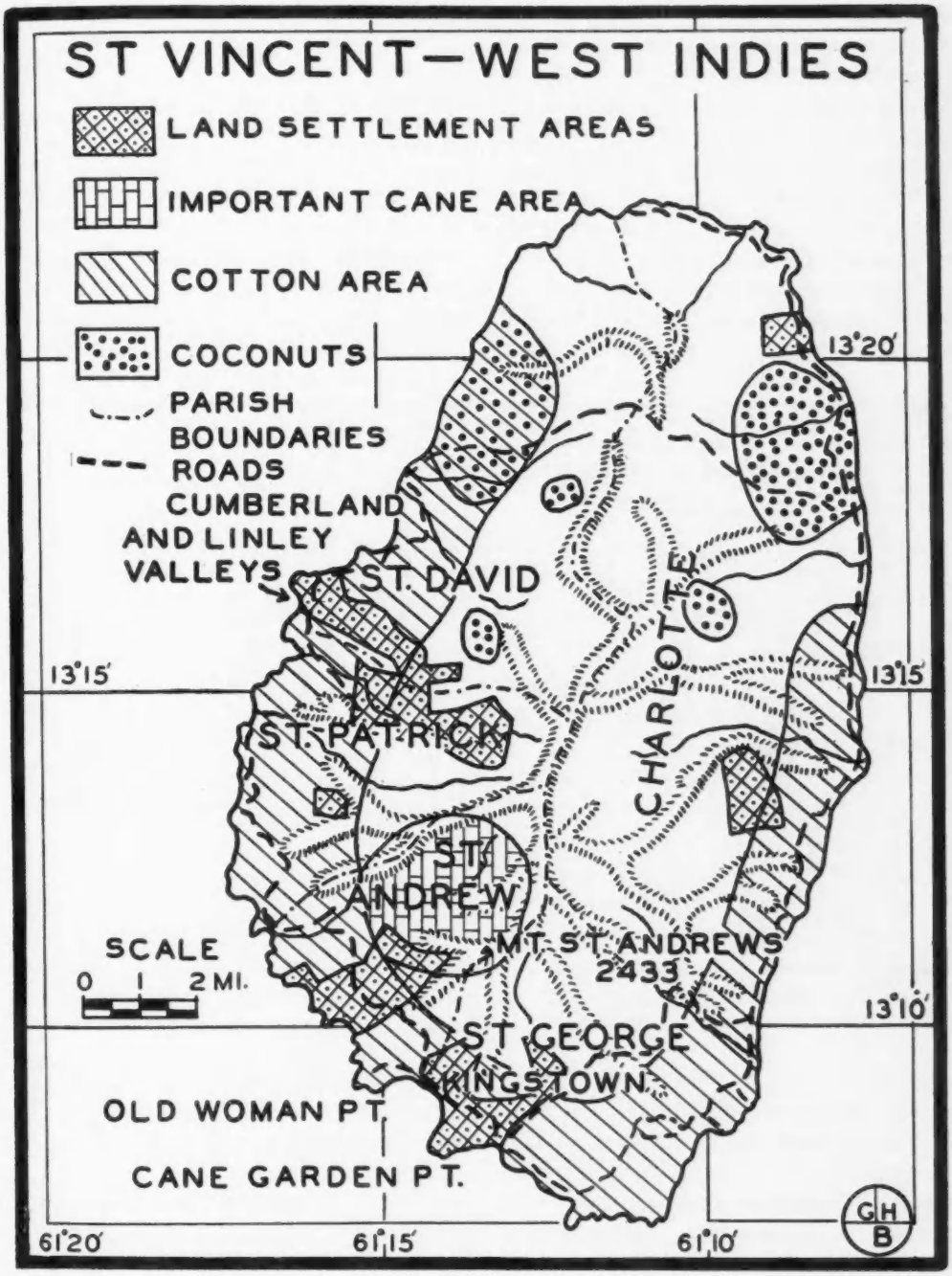


FIGURE 1.—St. Vincent Island. The distribution of coconut, cotton, and cane areas, as well as of the land settlement areas derived from former large estates. The character of the relief, the parishes, and the road net are also indicated.

1927 show variations from 80 to 138 inches, the average being about 100 inches. Insufficient information is available for the compilation of a rainfall map, but such scattered material as is available would indicate

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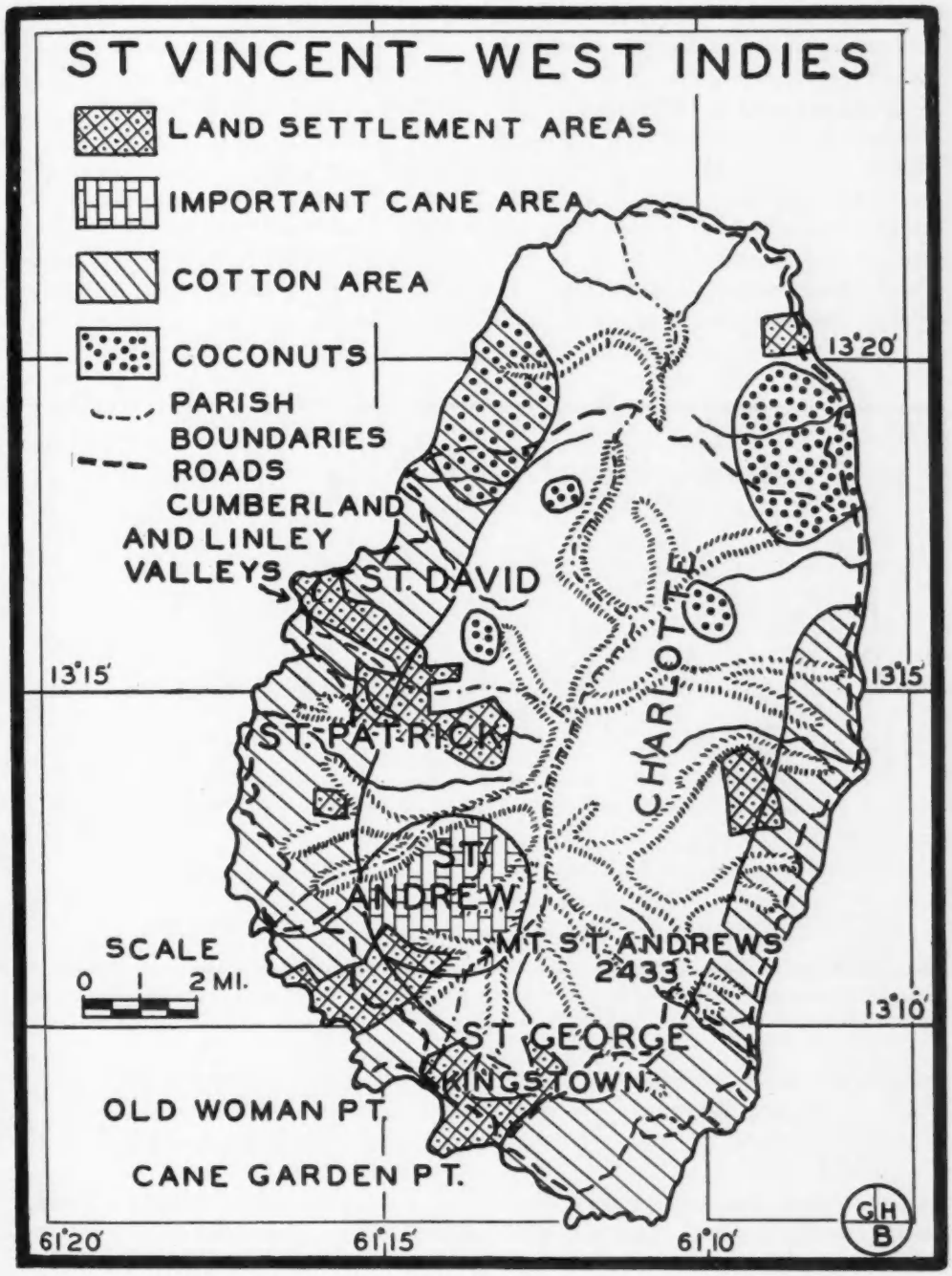


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that the rainfall is heavier in the higher parts of the interior—over 100 inches per annum; and lower on the coastal flats—60 to 100 inches. The rainfall determines crop distribution; cotton, for which the rainfall is reckoned high, is grown most successfully on the coastal flats of the drier regions, where rainfall and soil texture must be considered together. In St. Vincent areas with a rainfall of 60 to 80 inches are physiologically dry

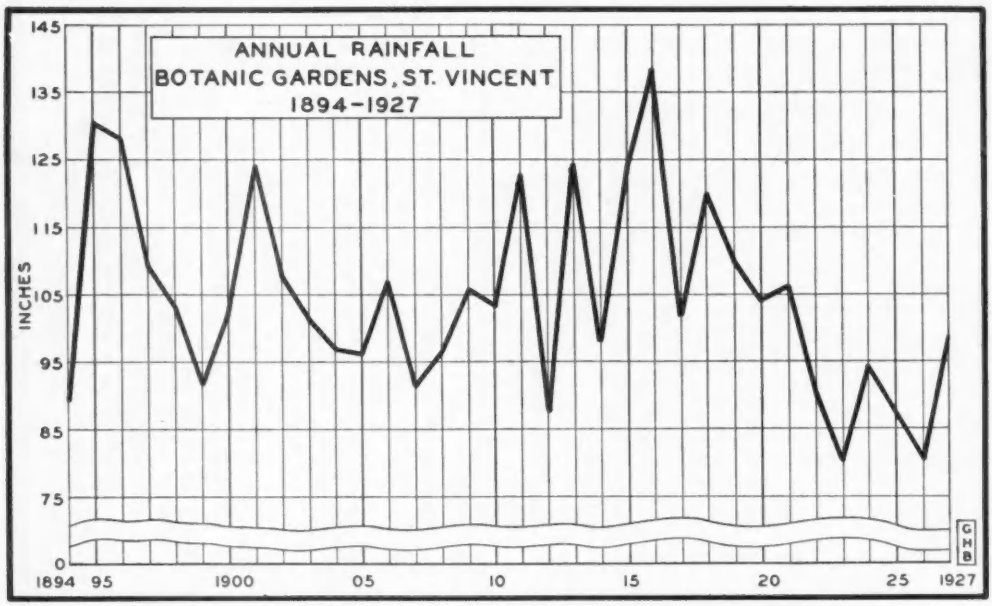



FIGURE 2.—The annual rainfall, 1894–1927, as gauged at the Botanic Gardens, St. Vincent. (From Report of Dept. of Agriculture, 1927.)

enough for cotton, whereas 40 inches might be too wet elsewhere. Seasonal distribution and rainfall is marked —less well, however, than in Trinidad—the wet season lasting from August to November. Since cotton requires ample rain during the vegetative season and dry weather when the bolls are setting, the rainfall distribution enables the cotton season to be arranged definitely. In an island like Antigua, uncertainty as to the advent of the rainy season and the irregularity of the distribution of rains are incompatible with suitable planting seasons for the satisfactory control of the pink bollworm.

## SOIL

In a memorandum prepared for the Royal Commission, Professor Harrison states: "The soils fall into classes, first, the very light sandy soils derived from volcanic ashes, which latter consist principally of somewhat glassy augite andesites; second, somewhat heavier soils of much finer texture, derived principally from basaltic and andesite lavas.

"Both classes of soils are deficient in retentive power for moisture, are low in contents of phosphoric anhydride, and especially low in lime in the form of carbonate. The lighter soils of the first class contain, as a rule, less potash than do those of the second. Nitrogen is present in both classes, in somewhat low pro-

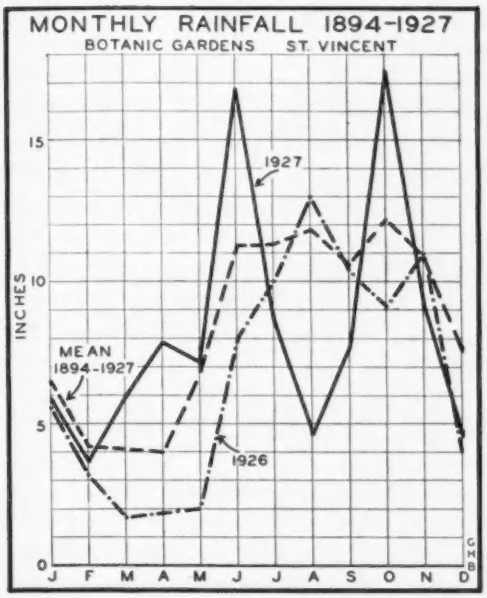



FIGURE 3.—Monthly rainfall, 1894–1927, as gauged at the Botanic Gardens, St. Vincent. (From Report of Dept. of Agriculture, 1927.)

portions for successful cane cultivation.

"The most marked characteristic of the St. Vincent soils is the state of insolubility of the phosphoric anhydride and potash present.

"I am inclined to consider that the condition of the majority of St. Vincent's sugar cane soils is one of relative exhaustion as regards the requirements of the sugar cane, and that this can only gradually be rectified by the adoption of manuring with very heavy dressings of vegetable composts, assisted by the use of artificial manures yielding considerable proportions of phosphates and potash and by applications of light dressing of sulphate of ammonia, nitrate of soda, or other nitrogenous substances."

In a report by Messrs. Ballou and Nowell after a visit to St. Vincent in 1916 it is stated that "The soil of St. Vincent is remarkably light, offering very little resistance to the passage of water . . . as a consequence of this condition, the atmospheric humidity is much below what would be expected from a consideration of the rainfall statistics of the island . . . in spite of an abundant rainfall St. Vincent presents the conditions of a relatively dry island."

Shallow soils are as a rule found on the hillsides, the flat lands having deeper and sometimes very deep soils.

In the past there has been a good deal of predatory cultivation, and the Agricultural Department has repeatedly had to urge the need for greater care in soil management and for increased use of manure.

Estates now give more attention to soil fertility and import increasing amounts of manure of recent years. The peasant generally neglects manuring but during 1925–1926 did more than previously. The cotton worm, however, decreased the yield of cotton and caused a falling-off in the practice in 1926–1927.

The hilly nature of much of the land necessitates hoe tillage. Successful experiments conducted in 1910 with ploughs and cultivators of various types demonstrated that machine work is better and cheaper than manual labor, but their use has not found favor.

## LAND TENURE

Large estates and small holdings characterize the land tenure but most of the land is held in estates of from 101 to 1,000 acres. Land ownership is not equivalent to land utilization for, although probably all the land of small proprietors is cultivated, the large estates are not so fully cropped. The estates are round the coastal fringe and those with largest acreages stretch from the coast inland, often bounded on either side by spurs and

finding their back boundaries on a ridge of the mountainous chain; a large proportion of the estate land is under forest and not directly used, although many of the planters give permission to laborers to clear the forest and establish a provision ground. On the lower hill sides soil depth limits cultivation. The cultivable land itself cannot all be utilized on account of inadequate labor supply. Data from two estates of about 1,700 acres each showing that only 400 to 500 acres are cultivated represent the general condition. In 1897 four or five men held most of the cultivable land of the colony, some estates with a total area of 11,826 acres being held by an absentee proprietor. Since then many of these properties have been sold and divided. Distinct estates are now distributed among many resident proprietors who manage their own properties.

### SMALL HOLDINGS

The evolution of the small holding is the story of the Land Settlement Movement intimately bound up with the recent economic history of the island.

### LAND SETTLEMENT SCHEME: GENERAL

The establishment of the settlements was an attempt to provide alternative employment for workers displaced by the depression in the sugar industry. Those who took up small holdings exchanged a poor prospect of money wages, coupled with some perquisites in the way of free provisions, for a plentiful supply of food, and a money return which depended largely upon their own efforts in producing a surplus. The movement proved successful; a self-supporting peasantry was established, and land that in many cases might never have been put under cultivation, or the cultivation of which might have been deferred for a long time, was profitably developed. In some measure the success must be ascribed to subsequent events which could not have been contemplated at the inception of the scheme. The Sea Island cotton industry was recommended some time after the settlement was started. Production was taken up by the small holders and, at a later date, 1910, the Government established a system whereby the peasants were paid an advance on seed cotton and a share in the profits on the lint when sold. Without the crop, the prospects of cash would have been reduced, and, without the action of the Government, the prospects of getting a good price would have been smaller. It was anticipated that something would be received from the sale of surplus provisions, but the extension of the colonial trade in provisions, which arose from the resumption of exchange crops—chiefly sugar—in the other islands and the diminution in their production of provisions, must have been greater than expected.

The movement, as anticipated at the outset, needed a good measure of benevolent control and in their early days the peasants were carefully trained by agricultural instructors.

Prior to 1897 land settlement schemes had been under consideration for some time by the Governments of the Windward Islands, and St. Vincent, in 1885, was the first to undertake a definite scheme.

Early settlements attempted on the Crown Lands which were inland, at considerable elevations, remote from markets and unprovided with roads, did not succeed. An im-

proved movement was initiated by the Royal Commission of 1897 when it recommended that "suitable portions of the thousands of acres of uncultivated fertile lands on the seacoast in the hands of private owners be acquired by the State and made available for settlements in small lots." In response to this suggestion, the Imperial Government made a grant of aid of £15,000 for the purpose of purchasing estates and settling the peasantry on them, and, during 1899, acquired several estates —a total area of 5,600 acres—in different parts of the island. These were surveyed and split up into small holdings of 1 to 7 acres, the usual size being 5 acres. The value of each small holding was so apportioned that the total value would equal the initial expenditure of the Government together with interest at the rate of 3 per cent per annum for twelve years. The conditions of tenure stated that an owner should reside on the holding, or on a house spot in one or other of the townships that were formed, unless he had been granted permission to reside elsewhere. Of the other conditions, the chief one from the agricultural point of view read as follows: "Every purchaser shall carry out such instructions as to the area of cultivation, the nature of the products to be planted in a particular spot, the manner in which the land is to be cultivated and the products cared for, and the handling of the products for market as may from time to time be given to him by the officers of the Imperial Department for the West Indies."

### *Attitude to the Scheme*

Although the estate owners had been cutting down cultivation on account of the depression in the sugar industry, they regarded the scheme with little favor. They considered it likely to produce a shortage of labor. The peasants themselves were suspicious. Some thought that land bought with money granted by the Imperial Government should be distributed free, others thought that when the land had been brought under cultivation the Government would appropriate it. The scheme, however, proved a financial and social success.

FIGURE 4.—Small holdings, Linley Valley. The belts of Angelin are planted as windbreaks. (Courtesy of Imperial Dept. of Agriculture.)

### *A Description*

The Linley Valley represents a typical land settlement. The estates, acquired in 1899, have an area of 1,571 acres. The small holdings are situated on ridges and valleys running down to the sea. The ridges occur at such short intervals that on practically all the holdings hillside cultivation has to be practised. The soil throughout is a light sandy loam of volcanic origin, in fact the Soufriere volcano is only five miles distant and a large quantity of sandy ejecta was deposited on the lands in 1902 and 1903. The annual rainfall ranges from 70 to 85 inches. To

protect the growing crops from wind, the Department planted lines of "angelin" (*Andira inermis*) or "Galba" (*Calophyllum Calaba, Jacq.*) between small holdings on exposed ridges. The estate was visited at frequent intervals by the Agricultural Instructor and the method of working has evolved largely as a result of his advice. One of the first

FIGURE 5.—A small holder's plot of cotton, upon which he depends for the little ready cash he needs. (Courtesy of Imperial Dept. of Agriculture.)

instructions given was that no bush, grass, or weeds were to be burned, but were to be bedded into the soil, piled into compost heaps or thrown into manure pens. The labor is provided by the settlers. Those who live on their lands are in the best position. Donkeys are the chief animals used for transporting produce to the coast, and the majority of the small holders possess one or two. It was possible, therefore, to get most of the people to erect donkey pens; these pens, which are placed on the poorest parts of the land, provide quite a large quantity of manure each season. Small stock, poultry, and a cow or two are also kept on most of the holdings.

### CROPS GROWN

The principal crops grown are cotton, ground provisions, arrowroot, cassava, groundnuts, black-eyed peas, pigeon peas, indian corn, sugar cane, plantains, and bananas. A considerable proportion of several of these crops is annually exported to neighboring colonies. The cotton, however, is nearly all sold to the Government or to local dealers for export to the United Kingdom.

Several crops are grown at a time with little attempt at rotation of crops. Fallowing is common. The peasant, unlike the planter, does not grow things primarily to sell, but to feed himself and his family. Cocoa and coffee take the place of tea, cassava and arrowroot of meal and starch. Indian corn is used for innumerable purposes. The holding looks like a mixture of crops haphazardly planted, but the peasant knows what he wants, and needs.

### FINANCING

As is common with small holders, the peasants were often hampered in their efforts for want of ready cash at critical periods of the year. To supply this lack, a small Agricultural Loan Bank was opened and successfully operated, Agricultural Credit Societies on the Raiffeisen system were mooted, and an Agricultural Credit Societies Ordinance was finally adopted, 1913. In a sense the St. Vincent Act was experimental. Its results were observed with interest by other West Indian Colonies and in 1915, the Governments of Trinidad and St. Lucia passed similar Ordinances. Undoubtedly the societies in St. Vincent were successful until 1922, when the hurricane, and a period of the post-war depression with falling prices for produce

created difficulties. The amount outstanding in 1926 was £345, but, considering that the total loans obtained since the formation of the societies amounted in 1926 to £35,328, and the total interest paid was £2,439, a failure to repay £345 in a period of 13 years can hardly be regarded as a sign of failure. The sympathies of those who grant loans, however, are alienated when any amount remains outstanding, particularly if it takes a long time and an enormous amount of trouble to collect it.

The success of the societies is prejudiced by the lack of discrimination in electing members for that strict scrutiny of the integrity and ability of prospective members which is such an important point in any credit society is not exercised.

To an appreciable extent the success of a society depends upon the conditions under which its members work and a close relation is found between the success of a society and the advantages or disadvantages of the land worked by its members.

## LABOR

The 1921 census gives the following figures for St. Vincent and the Grenadines: males 19,119, females 25,251 (totals of white and colored people) and these figures give a population of 331 per square mile. The density for other West Indian Islands is as follows: Barbados, 942; Trinidad and Tobago, 194; Grenada, 552; St. Lucia, 221; Antigua, 275; Montserrat, 373; St. Kitts, 345; and Jamaica, 204. The average annual increase in population, 1922–1926, is 20.21 per thousand. The chief town, Kingstown, with a population of 1,512 males and 2,311 females, is the center of government and trade. It probably owes its origin to the fact that Kingstown Bay is the chief inlet—the sea runs into the land for about three-quarters of a mile between Battery or Old Woman point on the northwest, and Cane Garden point on the southeast, distant from each other rather more than a mile. The town consists mainly of three long streets running parallel with the sea, and fills up the mouth of a valley, enclosed between two spurs running down from Mount St. Andrew to the coast.

The occupational analysis of the census gives the following classification—agriculture 12,754, commerce 802. On the basis of discussion with the planters it would appear that the supply of laborers is below the optimum, although the potential supply of labor from the existing laborers is much greater than the actual supply —the continuity and intensity of work is much less than it could be.

## ELEMENTS OF THE POPULATION

In the early days of French and English colonization of the Windward Islands of the West Indies, St. Vincent was in a great measure left to its native inhabitants, being, according to an old account "the most popular of any possessed by the Caribbeans." At the end of the seventeenth century there were two distinct races in the island, the yellow and the black Caribs. The latter, who became the dominant race, were supposed to be descendants of slaves, shipwrecked near the island, who had intermarried with the Caribs. Although St. Vincent was one of the islands declared neutral by the treaty of Aix La Chapelle in 1748, there were said to be in 1762, 800 white inhabitants mainly French, owning 3,000 slaves. The population is now

mainly composed of the descendants of these and others introduced at a later period by English colonists. (In 1834, there were 22,000 slaves and 1,300 whites.) Shortly after the island was ceded in perpetuity to the British Crown, 1763, it attracted the notice of the colonists in North America, Barbados, and Antigua who came in great numbers. They not only solicited and obtained grants of the unoccupied lands but insisted in appropriating those that belonged to the Caribs. As a consequence the Caribs broke out into rebellion. Their risings were ultimately suppressed in 1786 and most of them were deported to the island of Ruatan in the Bay of Honduras. There is still, however, a small Carib element amongst the people, particularly in the Soufriere district. Early in 1834, parliamentary resolutions regarding the abolition of slavery were announced and a system of apprenticeship—which caused discontent, proved inoperative and was abolished in August, 1838—preparatory to the changed conditions was brought into operation. There was a quiet and steady refusal to work for the offered wages; the combination was general and continued for several weeks. Eventually a few who reluctantly consented to labor in the fields accepted the amount offered. This diminution in available labor supply led to attempts to encourage immigration of others suitable for field work in the tropics. In 1846, the introduction of laborers from Madeira, the Canaries, the Cape de Verde Islands, and the Azores took place, and within a few years the number of immigrants amounted to 2,400. Coolie immigration was permitted in 1860 and the first cargo of East Indian laborers arrived in 1861. It is stated that "the system of importation although beneficial was of enormous cost to the proprietors" and little advantage was taken of it. At the beginning of the present century, when the economic condition of St. Vincent was still bad, it was used by British Guiana and Trinidad as a recruiting ground for laborers and most of those imported into Trinidad were coolies.

### QUALITY OF LABOR

In field work physical strength and endurance count for more than mental ability, and the laborers are on the whole of good physique. As in most tropical countries, hookworm is prevalent and seriously reduces efficiency but the campaign of the Rockefeller Institute between 1915 and 1918 has had a most beneficial effect. Both men and women work in the fields, many of the operations being performed entirely by women. The working value of a woman is reckoned at about one-half that of a man. Education is compulsory and the standard of literacy is high.

### STANDARD OF LIFE

The food of the laborers consists of provisions crops such as sweet potatoes, yams, eddoes, etc., produced on their own grounds. Indian corn forms an important article of diet. Large quantities of salt fish are imported from Canada and the United States. Valuable foods grow as free gifts of nature—the ratio of breadfruit trees to population is probably greater than in any other West Indian island. The houses are usually built of wood, but in some of the poorer districts they are constructed of wattles plastered over with mud; occasionally they are made of stone. The majority live in

villages, many live on estates, and some squat on their own pieces of ground.

### DEMAND FOR LABOR

A continuous but probably irregular demand for labor comes from the estates, and at particular periods of the year—planting and crop time—some demand also comes from the larger peasant proprietors.

The determination of wage rates is not the elaborate process that fixes wages in temperate and industrial lands. The laborer as a bargainer has not the strength of the trade union behind him, but he has the power that arises from independence. His requirements in the way of shelter and clothing are simpler than those of the industrial worker, he usually possesses enough land to provide himself with most of the food he needs and, if not, he can steal provisions without much fear of detection.

The planter must have labor, and a minimum wage rate may be set down as that necessary to induce the laborer to work. The general wage rate is about one shilling (24¢) per task, the task taking normally about five or six hours to accomplish. Most of the work is done by task, and the laborers are supervised by overseers and drivers who see that the work is done with reasonable efficiency and diligence. Although the laborer could work more than one task a day he rarely does so; like most people he does not like working in the hot sun and wishes to finish early.

### MOBILITY OF LABOR

Within the island itself, labor is said not to be very mobile; for example, the higher wages paid in certain regions do not induce immigration of laborers to those areas. There are, however, yearly emigrations, usually of a temporary nature, to other West Indian islands, chiefly to Cuba, and to the mainland. In January, the sugar-cane grinding season of Cuba begins and additional workers are required both in the field for cutting cane, and in the large factories (centrals) for crushing cane. Considerable numbers leave St. Vincent each year for the Cuban crushing season. This seasonal diminution in the supply of laboring men at a time when they are wanted for cutting the St. Vincent cane and making the syrup is not regarded favorably by the planters. In addition to the actual diminution of the local labor supply, those remaining become dissatisfied with local conditions and refuse to work. Abuses in the treatment of the laborers when abroad led to the enactment of Ordinance No. 10 to safeguard their interests and to regularize the position.

FIGURE 6.—A few representatives of the very small Indian element in the population, fishing in one of the small tidal channels off the coast.

## AGRICULTURAL PRODUCTS

The Report of the Royal Commission of 1897 portrayed a gloomy prospect for the island at that date. The declining sugar industry was on

the verge of extinction. The arrowroot industry prices had fallen off to such an extent as to augment materially to the depression from which the island was suffering. Very few small proprietors were operating, wages were low, able-bodied men had been emigrating and leaving women and children to shift for themselves, population was decreasing and the laboring classes were discontented.

Since that time the economic position of the island has improved greatly. The table of exports is a convincing guide to the absolute and relative importance of the different products in the early twentieth century.

Through the agency of the Imperial Department of Agriculture, Sea Island cotton was planted in 1903 and quickly became an important crop. The failing demand for some of its products and the rise of substitutes dims the immediate future of the industry.

Arrowroot has maintained its important position, although price fluctuations have obviously affected values.

Since 1915 the position of the sugar cane industry has improved; at the early period of the review it held a very minor position. At present syrup is being made in preference to sugar, in most cases by adaptation of the same or similar plants to those which were regarded as antiquated —with regard to sugar production— by the Commissioners of 1897.

The growing of coconuts on any appreciable scale, a post-war industry, has made rapid progress, most of the copra being sent to Trinidad for re-exportation. The largest single tract is in the Orange Hill district, an area that suffered greatly from the effects of the Soufriere eruption of 1902, and on which cultivation was subsequently abandoned for several years.

Cocoa was extended after 1897 but was damaged by the hurricane of

TABLE I

ST. VINCENT

TYPE AND VALUE OF THE PRINCIPAL EXPORTS IN POUNDS STERLING, 1904–1926

| | *1927* | *1926* | *1925* | *1924* | *1923* | *1922* | *1921* | *1920* | *1919* | *1918* |
|---|---|---|---|---|---|---|---|---|---|---|
| Sea Island | 39,204 | 63,158 | 57,533 | 50,218 | 47,292 | 31,750 | 70,532 | 163,433 | ..... | ..... |
| Marie Galante, lint and seed cotton | 3,919 | 2,982 | 1,511 | 592 | 638 | 827 | 681 | ..... | ..... | ..... |
| Cotton seed | ..... | 398 | 53 | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Cotton linters | ..... | 17 | 102 | 3 | 29 | 3 | ..... | ..... | ..... | ..... |
| Cottonseed oil | 1,266 | 583 | 1 | 467 | 300 | 395 | 299 | ..... | ..... | ..... |
| Cacao | 2,267 | 2,461 | 2,345 | 1,820 | 1,755 | 2,040 | 2,259 | ..... | ..... | ..... |
| Arrowroot | 53,309 | 45,807 | 53,174 | 51,361 | 31,829 | 26,141 | 21,216 | 52,771 | 42,222 | 95,828 |
| Cassava | 4,940 | 4,077 | 4,160 | 6,838 | 3,700 | 1,482 | 1,666 | 3,844 | 4,836 | 3,831 |
| Sugar (Crystallized and Muscovado) | 6,947 | ..... | ..... | 280 | 1,863 | 1,264 | 3,514 | ..... | 3 | 3,297 |
| Syrup and molasses | 10,496 | 16,523 | 19,672 | 15,758 | 18,711 | 9,862 | 9,878 | 27,828 | 10,722 | 4,796 |
| Rum | 2,452 | 3,536 | 4,019 | 2,107 | 2,627 | 2,589 | ..... | ..... | ..... | ..... |
| Coconuts | 52 | 102 | 20 | 22 | ..... | 6 | 82 | 144 | 47 | 22 |
| Copra | 10,083 | 9,826 | 5,512 | 5,430 | 2,959 | 2,435 | 1,359 | 430 | 156 | 189 |
| Groundnuts | 3,219 | 2,370 | 3,794 | 4,438 | 5,988 | 6,214 | 4,474 | ..... | ..... | ..... |
| Maize | 619 | 388 | 627 | 752 | 1,326 | 231 | 669 | ..... | ..... | ..... |
| Peas and beans | 352 | 476 | 866 | 984 | 1,595 | 1,640 | 1,472 | 952 | 1,392 | 1,666 |
| Vegetables | 1,693 | 2,100 | 2,587 | 2,544 | 3,216 | ..... | 4,595 | 2,742 | 2,672 | 3,391 |
| Nutmegs | 695 | 832 | 492 | 628 | ..... | ..... | ..... | ..... | ..... | ..... |
| Mace | 229 | 320 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Fruit | 276 | 148 | 271 | 143 | 137 | ..... | 185 | 619 | 586 | 114 |
| Whale oil | ..... | 148 | ..... | ..... | ..... | 504 | 625 | ..... | ..... | ..... |

In 1926 many new items were added. Poultry (£519); ginger (£13), limes and juice (£3), fire wood (£181), hides and skins (£146), miscellaneous spices (£100), wool (£26), logwood (£4).

In 1927 the values were: Poultry (£38), ginger (£26), fire wood (£268), and farine (£141).

1898; restorative measures were applied, and, although the promise at first seemed good, the natural conditions are so apparently unsatisfactory that the growing of the crop has not been encouraged. Although the island has abundant rainfall many areas are on the margin of physiological dryness so far as cocoa is concerned.

Ground nuts, important amongst the minor products, the dried nuts being exported to Trinidad, very often are grown as a catch crop with cane or cotton. Though the soil is admirably adapted to the crop, the advisability of extension is doubtful in several places on account of soil erosion.

A considerable inter-colonial trade is carried on in vegetables, and these, together with other minor crops, provide the peasantry a money crop subsidiary to cotton.

TABLE I (*Continued*)

ST. VINCENT

TYPE AND VALUE OF THE PRINCIPAL EXPORTS IN POUNDS STERLING, 1904–1926

| *1917* | *1916* | *1915* | *1914* | *1913* | *1912* | *1911* | *1910* | *1909* | *1908* | *1907* | *1906* | *1905* | *1904* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ..... | 14,366 | ..... | ..... | 33,886 | 33,393 | 40,790 | 25,987 | 28,791 | 29,162 | 16,922 | 6,059 | 3,890 | ... |
| ..... | 872 | ..... | 2,447 | 2,080 | 1,951 | 1,003 | 788 | 907 | 1,625 | 1,247 | 1,615 | 604 | 794 |
| ..... | ..... | ..... | ..... | 3,200 | 3,500 | 3,935 | 3,684 | ..... | ..... | ..... | ..... | ..... | ... |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... |
| ..... | ..... | ..... | ..... | ..... | 4,367 | 5,069 | 4,132 | 4,209 | 4,958 | 3,838 | 2,423 | ..... | ... |
| 40,296 | 37,619 | 44,689 | 57,806 | 53,607 | 40,854 | 40,430 | 30,089 | 31,792 | 27,713 | 25,556 | 24,357 | 20,523 | ... |
| 1,420 | 860 | 504 | 1,088 | 1,570 | 1,287 | 1,269 | 781 | 1,009 | 1,352 | 1,296 | 1,439 | 1,531 | ... |
| 11,584 | 9,520 | 3,253 | 1,586 | ..... | 2,647 | 5,405 | 3,561 | } 3,710 | ..... | ..... | } 3,811 | ..... | ... |
| 3,102 | 1,475 | 503 | 252 | 171 | 852 | 937 | 2,323 | | ..... | ..... | | ..... | ... |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... |
| 6,380 | 3,660 | 2,636 | 1,446 | ..... | 955 | 1,060 | 1,743 | ..... | ..... | ..... | ..... | ..... | ... |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... |
| 1,492 | 2,070 | 1,017 | 707 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... |
| 2,006 | ..... | ..... | ..... | ..... | 11,133 | 1,484 | 1,748 | ..... | ..... | ..... | ..... | ..... | ... |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... |
| 49 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... |
| ..... | ..... | ..... | | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ... |

## *COTTON*

Cotton, formerly grown extensively in the West Indian islands, was one of the important industries superseded by sugar. In 1799 the West Indies were the chief source of supply to the United Kingdom, furnishing in that year one-third of the cotton imports into Liverpool; from the United States came not more than one-fourth, while three years previously American cotton has made only one-sixth of the total. The subsequent discarding of cotton is usually ascribed to the extension of sugar and other crops yielding larger profits, but the probable influence of cotton stainers should not be overlooked. There was a slight revival of planting in St. Vincent during the Civil War in America, but afterwards cotton almost disappeared from the list of exports, the only locality where cultivation survived being the small island of Carriacou—a dependency of Grenada. The depression in the sugar industry at the end of the nineteenth century led to the idea of again taking up the cultivation of cotton as subsidiary, or in lieu of that of sugar. The idea was seriously entertained by the planters of St. Vincent, Montserrat, Antigua,

St. Kitts, and St. Lucia, and experimental plantings were started at St. Lucia—incidentally, one of the places where it has not been a success—in 1900. Many things favored the reestablishment of the industry. There were large tracts of cleared land formerly under sugar cane and well adapted to cotton. Soil and climate had long before proved favorable, and the planters viewed the project kindly as cotton cultivation readily fell into line with the estate routine with which they were familiar, and required almost the same field work as sugar. The cotton suitable for cultivation was the Sea Island type, a special variety usually commanding the highest price. In most islands an adequate supply of labor was available at a lower cost than in the United States, then the chief source of supply of Sea Island cotton. It did not require expensive machinery and implements. The crop could be grown and exported within a period of six to eight months from the time of planting. A central ginning factory costing a few hundred pounds would be capable of dealing with the crop produced on a comparatively large area.

During the year 1903, under the influence of the encouragement offered by the British Cotton Growing Association—founded for the purpose of encouraging the growth of raw material in new territories—considerable efforts were made to extend the cultivation of cotton throughout the British West Indian colonies and the following acreages were planted: Barbados, 1,200; Montserrat, 700; St. Vincent, 500; Antigua, 400; St. Kitts, 400; Nevis, 300; Virgin Islands, 100; St. Lucia, 80; Trinidad, 50; Anguilla, 20; British Guiana, 20; and Jamaica, 15. In addition several areas were put under cotton on the share system by peasants at Carriacou, Union Island, and other islets of the Grenadines. The total area under cotton in 1903 was probably not less than 4,000 acres. At this time ginning factories had already been erected at St. Kitts, Antigua, Montserrat, St. Lucia, and Barbados. A large three-story factory, containing eight gins and a press, on the plan of the best existing in the Sea Island districts of the United States was in course of erection at St. Vincent. This arose from a visit paid to the United States by the Commissioner of Agriculture for the West Indies and the Agricultural Superintendent of Barbados, for the purpose of collecting information with regard to the cultivation and preparation of Sea Island cotton. This was submitted to the planting

FIGURE 7.—Burning cotton stalks at the end of the season. A compulsory precaution against the Pink Bollworm. (Courtesy of Imperial Dept. of Agriculture.)

community in the *West Indian Bulletin*, Vol. 4, pp. 287–374.

Within a few years of its introduction, the industry was firmly established, and proved particularly important in those islands, which, unlike Trinidad and Barbados, were not able to carry on sugar production successfully when the situation improved.

## COTTON IN ST. VINCENT

In St. Vincent four years elapsed before the industry became a stable feature in the agricultural organization of the island. Excluding 1903–1907, the inception period, the acreage has varied from 2,404 (1916–1917) to 6,453 (1920–1921), the total lint produced varying from 160,168 pounds (1916–1917) to 614,508 pounds (1920–1921), and the yield per acre varying from 171 pounds (1907–1908) to 66 pounds (1916–1917). Values have fluctuated from £14,066 (1916–1917), when the British Cotton Growing Association bought in the crop at 18 d. per pound, to £163,433 (1919–1920) when some of the crop realized 10 s. per pound.

The cotton areas are mainly situated near the coast on the east, south, and west of the island. In favorable seasons the plant is accommodating and may be found in deep rich lands, and in dry, thin soil, but there are limits in both directions. The plant is a fickle bearer and is sharply influenced by factors far from obvious. "Growing succeeds best under conditions which induce a sequence of two well-defined periods in the life of the plant; a vegetative period of some four months during which the plant makes its growth, and a reproductive period of some three months during which the bolls are ripening" (Pamphlet 24, p. 20, of the Imperial Department of Agriculture). Soil fertility and rainfall distribution affect this growth. Rich soil tends to rank vegetative growth to some extent neutralized by dry weather. Rainfall beyond the vegetative period retards reproduction and reduces yield. Poor soil induces stunting, premature flowering, and a susceptibility to leaf diseases which are negligible under more favorable circumstances.

### *Area Devoted to Cotton*

The area devoted to cotton each year depends on price prospects and on prices and pests for the year past. An extension from 5,079 acres (1919–1920) to 6, 453 acres (1920–1921) was largely ascribed to a price ranging round 10 shillings per pound in 1919–1920. The difficulty of clearing the 1920–1921 crop and the necessary acceptance of 2 s. 6 d. from the British Cotton Growing Association brought about a reduction to 2,907 acres in 1921–1922. The 1926–1927 acreage was 6,156, but, in 1927, doubt as to the realization of the crop and fear of the cotton caterpillar led planters to limit their operations and 3,363 acres were planted.

The actual acreages devoted to Sea Island cotton as given in Table II indicate that the peasant proprietors take an important part in the production of the crop.

### *Peasant Production*

The acreage table shows that between 1920 and 1927 from one-fifth to almost a half of the annual total acreage in Sea Island cotton was in the hands of peasant proprietors. The acreage that can be devoted to cotton is limited—a random sample of 396 acreages from a list of 2,742

FIGURE 8.—Planting the cotton seed on the sides of the heaped up ridges. (Courtesy of Imperial Dept. of Agriculture.)

peasant growers showed the median acreage to be two to three rods.

This cotton is usually interplanted with other crops—corn and cassava—but, although the total returns may be greater, the cotton is more likely to suffer from pests and diseases.

ing up the hillsides; cane is grown in the accessible parts of the estates on land which is not so advantageous for cotton and arrowroot and where facilities are near at hand for manufacturing syrup. Estates growing both arrowroot and cotton are in a favorable position so far as the biological control of the cotton worm is concerned in the periodic epidemics of this plague which comes in a seven-year cycle from South America, probably Columbia, and hit St. Vincent north of Kingstown. The ravages of the pest would be far greater if it were not held in check by an egg parasite from the arrowroot fields. In general the estate cotton is better located than that of the land settlements.

### *Yields Per Acre*

The figures given in the Agricultural Report are hardly representative of either peasant or estate production. The whole crop is aggregated and divided by the total acreage so that the figure is likely to be high for peasants and low for

TABLE II

ACREAGES PLANTED, 1920–1928 *

| *Date* | *Total* | *Sea Island* | | | | | |
|---|---|---|---|---|---|---|---|
| | | *St. Vincent* | | | *Grenadines* | | |
| | | *Total* | *Peasants* | *Estates* | *Total* | *Peasants* | *Estates* |
| 1927–8 | 3,363 | 3,110 | 1,454 | 1,656 | 253 | 140 | 113 |
| 26–7 | 6,156 | 5,863 | 2,795 | 3,068 | 293 | 293 | ... |
| 25–6 | 4,986† | 4,539† | 1,865 | 2,674 | 448 | 301 | 147 |
| 24–5 | 3,294 | 2,810 | 912 | 1,898 | 484 | 285 | 199 |
| 23–4 | 3,387 | 2,802 | 1,048 | 1,754 | 585 | 425 | 160 |
| 22–3 | 3,562 | 3,057 | 765 | 2,292 | 505 | 505 | ... |
| 21–2 | 2,907 | 2,421 | 492 | 1,929 | 486 | 486 | ... |
| 20–1 | 6,453 | 5,744 | 2,011 | 3,733 | 709 | 709 | ... |

* Compiled from figures in Agricultural Report.

† Original figures gave also divisions of acre.

### *Estate Production*

Cotton is grown mostly on the flatter lands near the coast partly on the interior slopes; arrowroot has a wider distribution, overlapping the cotton on the low lands and stretch-

estates. Planters reckon to get one-third (120 pounds) to one-half (180 pounds) a bale (360 pounds) per acre. Yields year by year show a reaction to the discoveries of the scientists engaged in cotton work, to climatic conditions and the incidence of pests,

TABLE III

ST. VINCENT AND THE GRENADINES—MAXIMUM AND MINIMUM YIELDS OF SEA ISLAND COTTON AT DIFFERENT PERIODS

| *Period* | *Maximum* (lbs. per acre) | (*Year*) | *Minimum* (lbs. per acre) | (*Year*) | *Remarks* |
|---|---|---|---|---|---|
| 1906–1911 | 175 | (1907) | 124 | (1909) | Cotton a new crop. |
| 1912–1922 | 106 | (1914) | 66 | (1917) | Stainer prevalent in earlier period. |
| 1923–1925 | 161.6 | (1923) | 119.7 | (1926) | Disease and pest control measures coupled with more favorable weather. |

and a failure to maintain soil fertility. Some idea of variations can be deduced from Table III.

### *Planting Cycles*

We can start with the uprooting and burning of the old crop. In 1927 the destruction of the old cotton crop had to be completed before April 11 to initiate a close season for cotton until June 11—regulated by the Cotton Protection Ordinance No. 6 of 1924 and an Order in Council of March 12, 1927. This close season varies from year to year and is part of the system for pink bollworm control. Before planting between June and September, the land is weeded, the weeds ranged and banks made over them. If the seed used for planting comes from the Government Cotton Ginnery, it will have been passed through a Simon's Patent Heater at a temperature of from 125 to 140 degrees Fahrenheit and have been stored in a mothproof room prior to being used—part of the campaign against pests and disease. Four or five seeds are planted in a hole and the plants are later thinned out, supplies being put in where necessary. Manure may have been applied broadcast before planting or may be holed near the growing cotton. Weeding begins about a fortnight after planting, and continues every two or three weeks until about four weedings have been completed, and then repeated about once a month until about December; and, if a second picking is taken, further weeding is done. After the bolls have formed weeding must be done by hand as the hoe is likely to cut the roots and thus induce boll shedding.

The cotton picked by women and children from December to February is brought roughly clean to the drying house. There, it is more thoroughly cleaned, assorted into first cotton, second cotton, and stained cotton, then dried, bagged, and sent, as a rule, to the Government Cotton Ginnery in Kingstown. After the seed cotton has been ginned and the lint baled, the marked bales are stored or exported at the order of the planter.

FIGURE 9.—Second thinning of seedlings, after they have attained a fairly safe "stand." (Courtesy of Imperial Dept. of Agriculture.)

### *The Government Cotton Ginnery*

The Government Cotton Ginnery, erected under the direction of the

FIGURE 10.—A field of cotton in the Windward District. (Courtesy of Imperial Dept. of Agriculture.)

Imperial Department of Agriculture in 1904 on the plan of the ginneries that were seen in the Sea Islands of the United States during the visit of the Imperial Commissioner, is capable of an output of 4,000 to 5,000 pounds of lint per day. Cotton is ginned for estate proprietors as well as for small holders, and on a day when ginning is done for several small growers, the output will naturally be much less than when a large quantity of a single estate's cotton is ginned, as there must necessarily be some time lost between the changing of the marks.

The seed from the stained cotton is crushed and used for manure. The seed from the white cotton, after reserving such quantity as may be required for planting, is taken over by the oil expressing department of the Ginnery at a price fixed periodically by the Committee of Management. The crude oil is treated with caustic soda and steam in the refining kettle and the sediment is further treated with steam and caustic soda until it is boiled into a soap. The oil drawn off from the refining kettle is bleached by the use of hot water, filtered, and is then ready for sale as refined cotton seed oil.

The course of the seed cotton through the ginnery can probably be grasped better from the following "flow" sheet (Table IV).

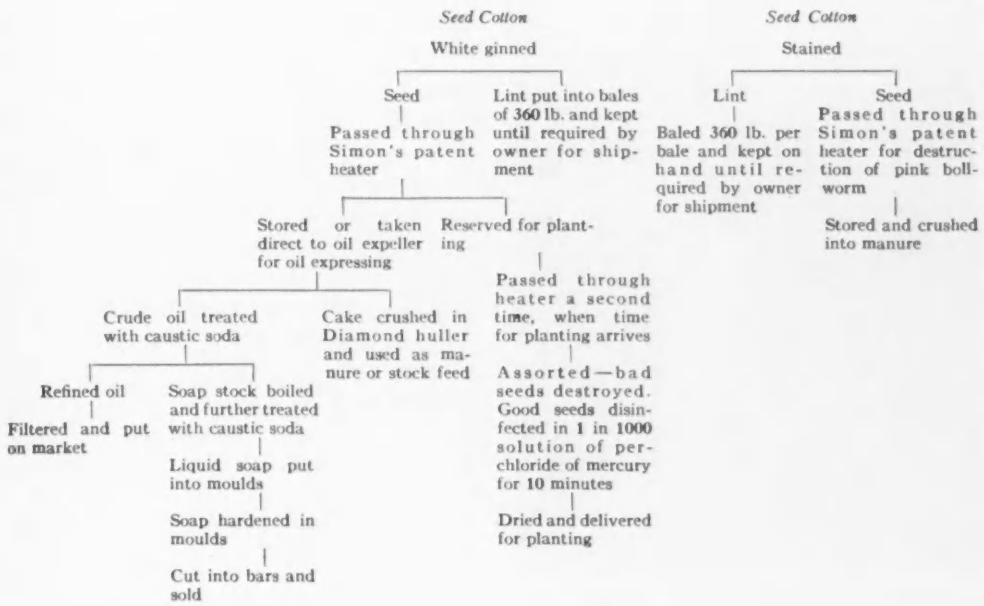
*Peasant's Cotton at the Ginnery*

Cotton is purchased from the peasants on a coöperative basis. The Committee of Management, having regard to the condition of the market, fixes the price to be advanced for white and stained seed cotton. All incidental expenses, including export duty, cost of ginning and bailing, etc., are charged to the Cotton Purchase Account, and, on completion of sales, a charge of 5 per cent on the total amount received by the Account is deducted by the Ginnery as commission for handling the cotton. Any balance of profit is distributed as a bonus calculated on the percentage of the amount paid to each small holder by way of an advance.

PRESENT CONDITION OF THE INDUSTRY

Reports of the British Cotton Growers' Association since 1922 reveal the depression that has spread over the British West Indian Sea Island cotton industry. The 1922 Report states that there was a lack of demand for Sea Island cotton accentuated by the cheapness of Sakel. The 1923 Report mentions the continuation of a low demand and the recommendation by the Imperial Department for the introduction of a new type similar to Jannovitch. Financial assistance was promised by

TABLE IV


Seed Cotton
White ginned
Seed
Lint put into bales of 360 lb. and kept until required by owner for shipment
Passed through Simon's patent heater
Stored or taken direct to oil expeller for oil expressing
Reserved for planting
Crude oil treated with caustic soda
Cake crushed in Diamond huller and used as manure or stock feed
Refined oil
Filtered and put on market
Soap stock boiled and further treated with caustic soda
Liquid soap put into moulds
Soap hardened in moulds
Cut into bars and sold
Passed through heater a second time, when time for planting arrives
Assorted—bad seeds destroyed. Good seeds disinfected in 1 in 1000 solution of perchloride of mercury for 10 minutes
Dried and delivered for planting
Seed Cotton
Stained
Lint
Baled 360 lb. per bale and kept on hand until required by owner for shipment
Seed
Passed through Simon's patent heater for destruction of pink bollworm
Stored and crushed into manure

the Empire Cotton Growing Corporation provided that the quality of the cotton in St. Vincent, Montserrat, Nevis, and Barbados, would not be depreciated. A later rise in prices held the matter in abeyance. The depression, however, continued and stocks began to pile up in the hands of the brokers and Fine Spinners.

In the summer of 1927, the situation became so serious that the Commissioner of Agriculture for the West Indies undertook two tours of the Sea Island cotton-producing islands, addressing meetings of planters, advocating a reduction of acreage under cotton, and suggesting alternative crops. It seems that unless new markets can be found—at present almost the whole of the cotton is sold in the United Kingdom—production must be halved.

At the end of 1927 St. Vincent had 692,850 pounds of cotton line unsold. Most of this (635,000 pounds) was in England. The Fine Spinners' and Doublers' Association offered to buy the unsold cotton with the understanding that production should be decreased to give them an opportunity to dispose of their stock. The offer was accepted. His Honor the Administrator, appointed a Committee under the Chairmanship of the Agricultural Superintendent to consider the question. When it was suggested to the other islands that St. Vincent would be willing to restrict the export of Sea Island cotton to 50 per cent of the average for the past five years if they would do likewise, they did not adopt the suggestion but left the planters to do the necessary restriction by agreement among themselves, whereupon the St. Vincent committee recommended the same method for the island.

### THE FUTURE

Some remarks from a recent book by Dr. Balls are worth noting here (*Studies of Quality in Cotton*, chapter XVII). Looking into the future, Dr. Balls in his recent study on qual-

FIGURE 11.—Picking cotton in St. Vincent. Cotton has been grown here only since 1902. (Courtesy of Imperial Dept. of Agriculture.)

ity in cotton states that "when there is any appreciable approach to complete population of the world, the arable land will be reserved for food production, out of sheer brute necessity; cotton will have to come from elsewhere, preferably from the forests which grow on land unapt for cultivation." . . . "The reaction between food and cotton will be evident long before the saturation point is attained and will necessarily show itself first as a concentration upon quality. Poor quality cotton will be the first thrown out of cultivation; its place on the land will be taken by food crops, its place in the mills by competing materials from the forests, waste lands, and waters. The better the quality, the more suited to specialized uses, the longer will it be worth while to reserve arable land for its growth." . . . "The problem of cotton supply in the future returns continually to a condition of justification by quality. Even at the present day, and in spite of the apparent contradiction afforded by the limited market for such cotton as the Sea Island from the West Indies, there are indications of a continuing and increasing insistence upon quality. A cotton industry which concentrated on quality would necessarily be different from its present form." . . ."The nature of the probable change may be summarized as a change towards a 'structural' use of cotton in place of a 'covering' use. Cotton has advantages of strength combined with flexibility for such structural purposes as the pneumatic type, some flexible couplings, belting, or typewriter ribbons in which it should be able to hold its own."

*ARROWROOT*

Arrowroot, grown in and exported from St. Vincent as early as 1830, continued the chief source of supply. The very pure water, resultant upon geological structure gives St. Vincent

FIGURE 12.—Ginning floor of the Government Cotton Ginnery, to which many of the small planters bring their crop. (Courtesy of Imperial Dept. of Agriculture.)

an almost monopolistic natural advantage. The arrowroot industry was in a fairly prosperous condition until 1888, then a depression developed attributable largely to decline

in the quality of the starch. The exports valued at £61,313 in 1892 were valued only at £30,506 in 1896. The Royal Commission of 1897 called attention to its depressed condition and the crop remained unsatisfactory until about 1910 when some improvement was effected by the inauguration of an association for price control—the Arrowroot Growers' and Exporters' Association. The outbreak of the Great War caused an increase in freight rates and prices were low for some time although they returned later to a remunerative figure and continued high until the end of the war. In 1924, the Association coöperated in an attempt to advertise the product at the British Empire Exhibition, Wembley, and St. Vincent arrowroot has been represented at many exhibitions since that date. At present marketing is being investigated by an expert attached to the West India Committee.

The 1926 exports are about 50 per cent higher than those of 1921 and their total value is more than double; the increase being largely due to the extension of the United States market.

The crop is grown by both estates and peasants. Some of the Land Settlement Areas have factories attached. There are variations in the quality depending on whiteness. The best grades come from estates with a natural advantage like clean water combined with careful manufacture and efficient organization. The crop is less particular in its requirements than cotton and consequently the area over which it can be grown is relatively great. Production could easily be extended but past expe-

FIGURE 13.—Taking baled cotton by lighter from shore to ship. (Courtesy of Imperial Dept. of Agriculture.)

Subsequently, stocks began to accumulate and in 1919 planters reaped only a portion of their crop, about half the usual quantity of arrowroot being exported. The statistical position in recent years can be seen from Table V.

TABLE V
ARROWROOT EXPORTS

| *Year* | *Quantity in Pounds* | *Value in Pounds Sterling* |
|---|---|---|
| 1921 | 2,093,358 | 21,216 |
| 1922 | 2,692,130 | 26,141 |
| 1923 | 2,177,182 | 31,829 |
| 1924 | 2,952,535 | 51,361 |
| 1925 | 3,190,412 | 53,174 |
| 1926 | 3,291,553 | 45,807 |
| 1927 | 3,195,478 | 53,309 |

rience has shown that any extension produces a surplus in the hands of brokers, and, consequently, low prices. Current prices and price prospects in relation to cost of production determine the acreage planted or "ratooned."

### CULTIVATION AND MANUFACTURE

The plant is a herbaceous perennial with a creeping root-stock which gives off fleshy cylindrical branches or tubers, covered with pale brown or white scales and afterwards ringed with their scars. It is at the period when these tubers are gorged with starch, immediately before the season of rest, that it is ripe for use.

After the land is cleared and hoed, the top roots of the tuber are lightly buried. Leaves begin to show above the ground in about three weeks and three weeks later the plants are large enough to be weeded. Supplying and moulding are done later but the most frequent operation is repeated weeding. When the crop ripens in 10 to 12 months the leaves dry and the stalks bend at the root till the whole plant lies prone. In reaping, the roots are hoed out. The top joints are broken off and buried for the next crop. This system of ratooning—as it is wrongly designated locally—often runs on for considerable periods. The starch content varies according to the age of the arrowroot, and, unless it is mature, poor yields are likely to be obtained. The lifting of the crop must, however, be fitted into the estate routine often preventing digging at the optimum stage. Yields are said to vary from 5 to 20 barrels of 220 pounds of arrowroot starch per acre. One prominent planter expressed the opinion that the average yield over the whole island is 8 barrels per acre.

The arrowroot starch may be separated on a small scale in the same manner as potato starch is frequently prepared, by peeling the root and grating it in water, when the starch falls to the bottom. The liquor is then drained off, and the starch is purified by repeated washings till it is ready for drying. On a large scale manufacture is conducted with specially arranged machinery. On arrival at the factory, the rhizomes are

FIGURE 14.—Digging arrowroot, for which St. Vincent remains one of the chief sources of supply. The crop is grown by both estates and peasants.

washed and cleaners scrape off the roots. The cuticle of the tuber contains a resinous matter which imparts color and a disagreeable flavor to the starch. A great deal of attention was formerly given to the skinning and peddling of the tubers,

but now in most cases such care is not taken.

In St. Vincent, the motive power for the factories is provided by water wheels. The factories range in capacity from 10 to 20 barrels a day, employ 15 to 35 workers and cost 20 shillings to 35 shillings a day to operate.

The "bittie" or fibrous residue taken from the strainers and the dirty starch taken from the top of the settling vats are not wasted. The latter is fed to pigs and poultry and the former may be applied as manure, used for bedding cattle and making pen manure, or fed to cattle. The use of the material for paper making and as a source of industrial alcohol has been investigated but neither seems economically feasible.

### *SUGAR*

Previous to 1907 the sugar industry of St. Vincent dragged along for years, although improvement was noted in some of the other islands. The year 1907–1908, however, witnessed the rehabilitation of the Carib country—rendered barren by the eruption of 1902—when it was planted with sugar canes to the extent of 300 acres, the first attempt of the present century to renew the sugar industry. The sugar industry was considered important in certain districts because it attracted and kept laborers on estates. A general revival began in 1915–1916 as a result of the high war prices and the improved outlook quickly led those planters whose works could be put into fair order to replant considerable areas with canes. In 1916–1917, sugar and sugar products took the third place in the exports. Cultivation, however, was limited by the capacity of the few and small mills.

At the beginning of the nineteenth century muscovado sugar attracted some attention, but the planters later turned their attention to fancy molasses and rum. When the Great War began muscovado was again produced and more attention was given to centrifugal sugars. After the war this gave way to the manufacture of syrup for which a market was found in Canada later supplemented by demand from the United States. Two estates in the island recently erected new and improved sugar machinery and crystal sugar was again exported in 1927. The different types of sugar-cane products exported and the direction of the exports can be seen from Table VI.

Cane will grow in most parts of the island. It occupies the land for a period of from 12 to 15 months. Whereas in important sugar countries, a good deal of attention has been given to the breeding of types of canes particularly suitable to the country and having good commercial qualities, no particular cane seems to be grown by the St. Vincent planters, although work on cane varieties is now being done by the Agricultural Superintendent. The present yields, about 15 tons of cane per acre—low, even for the West Indies, must in part be ascribed to the depletion of inorganic matter in the soil. Sugar cane is a luxuriant vegetative growth and needs rich nutriment.

In the majority of the estates, the present plant is the antiquated equipment in use before the depression at the end of the nineteenth century, but on a few estates more up-to-date machinery has been installed. The eleven roller mill common in modern

sugar factories is often supplemented by a shredder, a series of revolving knives which cut the cane into small pieces before it enters the rollers. Throughout St. Vincent, the inferior three roller mill is general, and some of the planters even put the cane through the mill with the trash on, reducing the already low extraction efficiency, because some proportion of the juice is soaked up by the dried trash and is lost. Again, in a modern factory, the juice from the crushed canes is clarified, heated, settled, about 20 tons of cane. The small size of the St. Vincent factories in comparison with those of the important producing countries is seen from the following figures which give the tons of cane ground per hour in the factories of the more important sugar-producing countries.

TABLE VII

AVERAGE CRUSHING CAPACITY OF MILLS

| *Country* | *Tons of Cane per Hour* |
|---|---|
| Cuba | 75 |
| Java | 25–50 |
| Hawaii | 25–50 |

TABLE VI

ST. VINCENT

TYPES OF SUGAR-CANE PRODUCTS MADE, VALUE AND DIRECTION OF EXPORTS, 1921–1926

(Compiled from the Blue Book)

| *Type of Sugar and Direction of Export* | *Years and Value of Exported Sugar-Cane Products* | | | | | | |
|---|---|---|---|---|---|---|---|
| | *1921* | *1922* | *1923* | *1924* | *1925* | *1926* | *1927* |
| Sugar: | | | | | | | |
| Muscovado | 150 | .... | .... | .... | .... | .... | .... |
| Canada | 34 | .... | .... | .... | .... | .... | .... |
| United Kingdom | 116 | .... | .... | .... | .... | .... | .... |
| Centrifugal | 3,364 | 1,264 | 1,863 | 280 | .... | .... | .... |
| Grenada | 2,605 | 118 | 1,191 | 280 | .... | .... | .... |
| United Kingdom | 759 | 1,146 | 672 | .... | .... | .... | .... |
| Total | 3,514 | 1,264 | 1,863 | 280 | .... | .... | 6,947 |
| Syrup and molasses: | | | | | | | |
| Canada | 9,877 | 9,856 | 16,537 | 15,574 | 15,974 | 7,551 | .... |
| United States | .... | .... | 1,500 | 181* | 3,646 | 8,422 | .... |
| Barbados | .... | 2 | 672 | 2 | .... | 550 | .... |
| Other West Indian Is. and United Kingdom | 1 | 4 | 2 | 1 | 52 | .... | .... |
| Total | 9,878 | 9,862 | 18,711 | 15,758 | 19,672 | 16,523 | 10,496 |
| Total | 13,392 | 11,126 | 20,574 | 16,038 | 19,672 | 16,523 | 17,443 |

* This must be a mistake: 188,800 gallons were exported to Canada, valued at £15,574; 72,295 gallons were exported to U. S. A., valued at £181.

evaporated in multiple effets, grained and crystallized in vacuum pans, and cured in the centrifugal—the final product being raw sugar. In St. Vincent, the final product is syrup, and the juice, after only slight measure of clarification, is concentrated into syrup in open pans and allowed to cool, after which it is barrelled and exported. About 600 gallons of syrup a day are produced in the factories, approximately equivalent to 2 tons of sugar, which would have been produced in Trinidad from

The survival of small scale enterprise in St. Vincent is largely due to topography. When the muscovado sugar industry of the West Indies was at its height, the representative sugar estate was a small scale enterprise and the St. Vincent units conformed to the usual standard. Competition and technical advances led to the growth of large scale units and the "centrals" with their big capacities required extensive areas from which to draw their canes. Level or

slightly undulating lands were provided almost monopolistic advantages where roads, traces, and railways could be conveniently laid out and act as feeders to the sugar factories. Quite distinct from the series of historical events that put St. Vincent at a disadvantage in 1897 so far as sugar producing was concerned, the transport difficulties arising from relief would have proved wellnigh insurmountable if an attempt had been made by planters to increase the size of the unit and accommodate themselves to changed conditions. Like so many of the owners of small scale units in other industries, they sought a solution in specialization and, excepting the abnormal war period when centrifugal and muscovado sugars were produced they have turned profitably to the making of fancy molasses syrup. The apparatus, methods, and product have been justifiably criticized, but the industry remains a good example of a reaction to changed external circumstances.

# ECONOMIC GEOGRAPHY OF THE HAWAIIAN ISLANDS

*Otis W. Freeman*

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THE Hawaiian Islands contain only 6,454 square miles, yet for their size are one of the most valuable parts of the United States; 400,000 acres, about 10 per cent of the total area, is under cultivation, and from this small area the territory has exported an average of $110,000,000 worth of products each year for the past seven years. As the population of Hawaii is about 300,000, this represents nearly $400 for each inhabitant of the islands. Besides, imports amount to $300 for each inhabitant so that the total foreign trade equals $3,500 for a family of five persons. It is probable that there are very few parts of the world that equal this record.

The Hawaiian Islands occupy the southeastern portion of a submarine platform in the north Pacific and include eight inhabited islands, *i.e.*, Kauai, Niihau, Oahu, Maui, Molokai, Lanai, Kahoolawe, and Hawaii. The group is just south of the Tropic of Cancer. The islands are all essentially of volcanic origin and on the island of Hawaii, Mauna Kea reaches an altitude of 13,825 feet. The group is in the Trade Wind belt and the larger islands are high enough to markedly affect the rainfall. Thus, the rainfall on the windward side of an island may exceed 300 inches annually while a few miles away on the leeward side it may be only 10 to 20 inches. Occasional torrential rains have deeply eroded the older volcanic domes. The mountains, including even the steepest slopes, are usually covered with dense vegetation. The common soil is a laterite resulting from the weathering of a basalt under subtropical humid conditions. High temperatures and frost are equally unknown in Hawaii.

A typical Hawaiian island consists of one or more great domes built from basaltic flows with some associated pyroclastics. This often has been so eroded that only knife-edge ridges and a few "plateaus" may be left to represent the original surface. There are a number of well-defined physiographic regions from the sea to the mountain top that affect the economic geography: (1) Along the shore are the beaches, sand dunes, and raised coral reefs. This is a zone where the Hawaiians formerly built fish ponds. Today it is often devoted to pleasure resorts. The beaches and raised reefs have poor soil and are usually little used for agriculture, although the cocoanut palm and algaroba can be grown. At Ewa on Oahu, by artificial fertilization and irrigation of the thin soil covering raised coral reefs, good crops of sugar cane are being raised. (2) Coastal plains, alluvial slopes, deltas, and valley floors are covered with fluvial and alluvial deposits. These lands are generally flat and easily irrigated. The lower portions may be devoted to taro, rice, and bananas. The better drained areas are used for sugar cane. (3) In the flow ends and steep valley slopes, there is a limited

use for grazing. Its chief use, where forest covered, is to help conserve the flow of streams and to provide useful wood and fruits. (4) The old sloping flow surfaces are much used for cane fields at lower altitudes and pineapples at higher altitudes or where water is not available for irrigation. New flow surfaces may be so rocky as to be of little use except for grazing and tree crops. The old flows were mostly originally forested and the higher flow surfaces, especially on the windward side of the islands, are still usually forested. On the upper parts of the great lava domes of Haleakala on Maui and Mauna Loa and Mauna Kea on Hawaii are excellent grazing lands above the forests. (5) The mountain summits may be either (a) flat, swampy, summit plateaus where the top coincides with a zone of maximum rainfall; (b) narrow, steep, serrated divides where erosion has removed the original "plateau"; or (c) high domes, treeless at their summits with frost and snow in winter. The mountains are of importance for forest products, water supply, and grazing. These various geographic regions are sometimes sharply defined from each other and sometimes graded together without prominent boundaries. One or more of them may be absent from any selected situation on an island. Oahu shows all of them except high domes.

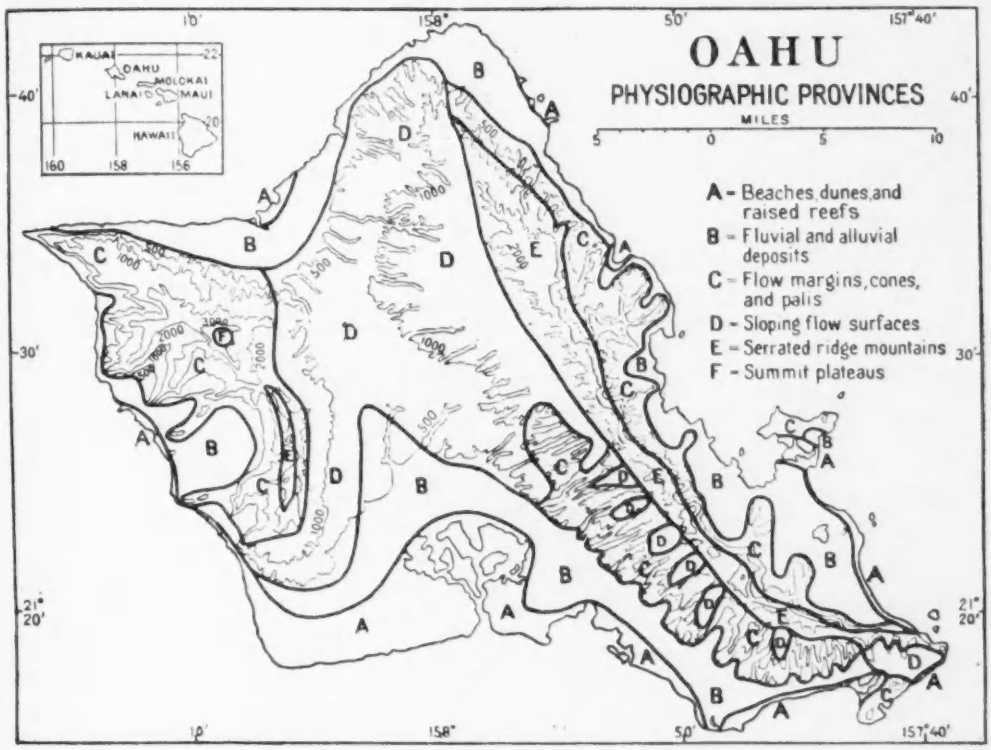


FIGURE 1.—Physiographic provinces of Oahu. The island consists of two basaltic domes connected by a lowland. Only a small remnant, Mount Kaala, remains of the original summit. Oahu is typical of the entire Hawaiian group. (Courtesy of the *Geographical Review*, published by the American Geographical Society, New York.)

## MINERAL RESOURCES

Except for construction material, mineral resources are negligible in Hawaii. Beach sand is gathered for cement work and basalt is crushed for road material. Coral has been quarried for buildings. Salt was formerly made from the water of salt lakes, but in late years it has proved cheaper to import it. Some plantations make lime for the liming tanks in their sugar mills, using molasses for fuel in the kilns. Cement manufacture has been tried unsuccessfully. Some of the soils are high in iron and manganese, but with the lack of fuel in the islands and the abundance of such materials elsewhere it is improbable that an iron industry will ever develop in Hawaii.

## WATER RESOURCES

Water resources are of tremendous importance in the Hawaiian Islands. All the sugar raised on Kauai, Maui, and Oahu is irrigated. Only on windward Hawaii is sugar raised without irrigation. Since most of the sugar is raised on the leeward side of the islands except in the case of Hawaii, the development of irrigation water is a matter of great importance. Streams and springs have been fully utilized and reservoirs to store flood waters have been built.

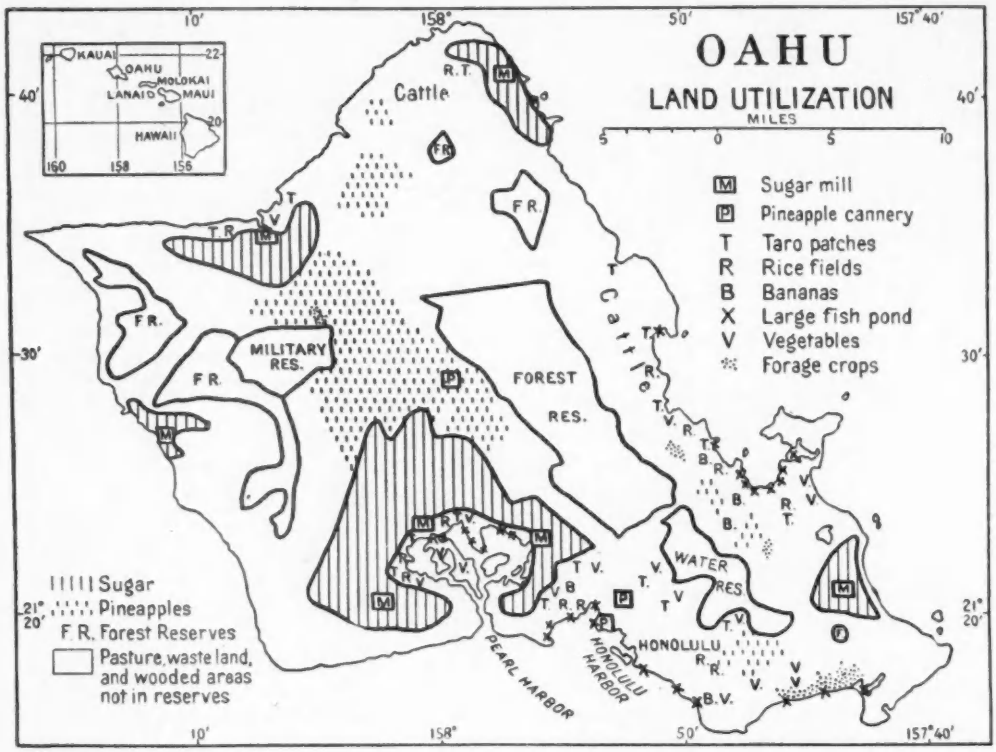


FIGURE 2.—Close relationship between relief and land utilization in Hawaii is evident. In Oahu sugar occupies lowlands and fluvial plains up to elevations of about 1,000 feet. The sloping flow surfaces are used for pineapples to elevations of 2,000 feet. Taro and rice are restricted to the low coastal plain which is easily irrigated. Vegetables are grown in mountain valleys where soil and climate are suitable. Forage crops are mainly grown for feeding dairy cows. (Courtesy of the *Geographical Review*, published by the American Geographical Society, New York.)

FIGURE 3.—Algaroba trees—the most useful trees in Hawaii. The blossom furnishes bee pasture; the wood, fuel; and the bean, cattle food. It grows on dry, poor soil. (Photo by H. S. Palmer.)

Tunnels have been run into mountain sides to intersect ground waters and on Oahu a tunnel was extended entirely through the Koolau Range to bring water from the rainy windward to the dry leeward side of the island. A great ditch serves the same purpose on Maui. On Oahu a great deal of water is pumped for irrigation, one plantation alone pumping enough water in a day to supply a city of more than one million persons. Honolulu is mostly supplied from pumped wells and artesian wells. Water is so valuable that ditches are being concreted to prevent loss by seepage after development. Besides sugar, crops of rice, taro, fruits, and vegetables are irrigated. On Hawaii streams are sometimes diverted and used in flumes to transport cane to the mills. There is comparatively little water power available in the islands. According to an engineer, Alonzo Gartley, about 8,000 H.P. is developed from water power plants in the Territory of Hawaii and a total of 26,500 H.P. more could be developed, half being on Kauai.

## FORESTS AND TIMBER PRODUCTS

The forests of Hawaii consist of both native and introduced species. Originally the islands were almost completely covered with forests except in the driest places and coldest mountain tops. Most of the arable land now covered with sugar cane, pineapples, and pastures was once forest. The Hawaiians introduced the banana, pandanus, cocoanut, and kukui or "candlewood" tree. Koa is a native wood that is hard and takes a good polish. It is somewhat used for furniture and curios. Sandalwood was the most important export from Hawaii from 1800 to 1835, until the tree was nearly exterminated. It was secured by American and European traders and sold in China. The algaroba, a variety of mesquite, has been introduced and is the most useful tree in the islands. Algaroba trees grow rapidly and flourish on waste land that will grow nothing else. The wood is excellent fuel and makes good charcoal, the blossoms are a very good bee pasture,

FIGURE 4.—Cane fields near Pearl Harbor, Oahu. The sugar cane is growing on the lower flow slopes and coastal plains. The eroded lava dome of the Waianae Range is in the background. (Photo by R. J. Baker, Honolulu.)

and the beans are a nutritious cattle food. The guava grows wild and its fruit along with some other wild fruits is used for jelly and jams. The most important use of the Hawaiian forests is for the conservation of water for irrigation. To insure the perpetuation of the forests for this purpose, 800,000 acres have been included in forest reserves.

### FISHING

There are many hundreds of species of fish in the waters around Hawaii but the commercial catch is not especially large. Many of the fish taste delicious. The Hawaiians built many fishponds to increase the amount of fish available. Mullet were chiefly raised in the ponds. Some of the ponds are still used but most of them have fallen into disuse. About $1,000,000 worth of fish are caught annually which does not supply the local market, as nearly $1,000,000 in fish products is imported each year. Exports are inconsiderable. Japanese control the fresh fish industry, as 65 per cent of the 1,297 fishermen in 1919 were of that race.

### AGRICULTURE

Two industries, sugar and pineapples, dominate the agricultural and business life of Hawaii. In 1926, a year of low prices for sugar, there were exports from Hawaii worth $105,732,167 of which $69,533,912 was sugar and $34,578,571 were pineapples. The 1926 crop of 787,246 tons of raw sugar was the largest on record but the crop of 1920, a year of high prices, was worth $119,490,663 in exports of sugar.

#### SUGAR

After planting, sugar cane in Hawaii matures in about 18 months and continues to produce about ten years before replanting is required. Sugar has been grown in the islands for more than a century but until a reciprocity treaty was entered into with the United States in 1876, the industry never attained great importance. In 1875 exports of sugar were 12,540 tons; by 1890 this had increased to over 125,000 tons and today is nearly 800,000 tons, and is expected in the future to exceed 1,000,000

tons. This can be attained by continued improvement in yields and the planting of dry lands, as on Molokai, that might be developed by expensive irrigation works.

Practically all sugar in Hawaii is grown by the plantation system, as small growers rarely have the special knowledge or exercise the care needed to successfully grow the crop. The cane is grown on the islands of Hawaii, Maui, Oahu, and Kauai by 49 plantations and the raw sugar is made in 44 mills. There are 42 plantations that are complete entities from the cane fields to the mills. There are seven small plantations whose cane is ground by neighbors, and there are two custom mills on Hawaii for the accommodation of homesteaders. One plantation on Maui produced nearly 68,000 tons in 1925. There are 14 plantations that produced in 1926 over 20,000 tons each. The Ewa Plantation on Oahu leads in sugar production per acre with a yield of nearly 12 tons of sugar per acre.

Sugar cane is grown on land with slopes sufficiently gentle for cultivation and irrigation. The cane fields are on the coastal plains, in large valleys, and on the lower flow surfaces up to altitudes of about 1,000 feet. On Maui and Oahu much of the cane is grown on the central lowland of those islands that lies between two lava domes. Hawaii raises the majority of its cane on the lower, eastern flow slopes from Mauna Loa, and Mauna Kea. The plantations are generally managed in a highly efficient manner. Around the mill is the plantation village with stores, school, and homes for the workers. Most of the laborers are Japanese and Filipinos, with some from a score of other nations. Wages start at $1.10 per day and are supplemented by free rent, water, light, and medical attendance. Most of the workmen save money and live on a higher scale than in the countries from which they came. The total employed in the sugar business directly is 49,000, which amounts to about one-sixth of the entire population of the territory, and, of course, many others are indirectly supported by the industry. Approximately $175,000,000 is invested in the sugar industry. In 1926 the production of raw sugar from the four producing islands was Hawaii, 276,852 tons; Oahu, 213,705; Maui, 158,950; and Kauai, 135,739.

The plantations use the most modern equipment. There has been $19,000,000 invested in irrigation works alone and more is being expended. Plowing is done by stationary tractors alternately reeling in a double action plow which plows the soil to a depth of 24 to 30 inches. Harvesting is still done by hand, as a practical machine has not yet been invented. The cane fields are usually burned over to remove the leaves just before harvest, which reduces the labor cost of the harvest without much reducing the sugar content if the cane is cut promptly. Portable railroads are often used to transport the cane to the mills. The mills are of the most modern character and much of the machinery used has been invented in Hawaii and is manufactured at the Honolulu Iron Works. There are even exports of sugar mill machinery to the Philippines and other countries. One mill on Oahu completely refines the sugar for the local market. Exports of sugar are made as raw sugar in jute bags to two great refineries on San Francisco Bay. The largest of these is owned by 33 plantations of Hawaii that produce about 80 per cent of the crop.

Rotation of crops is not practised on the sugar plantations. Great quantities of commercial fertilizer are used instead. Chemists are constantly employed in soil analyses to determine the needs of the soils. Some plantations add to their fields more than $50 of fertilizer per acre in a year. There is little more sugar land under cultivation than twenty years ago. The increase in sugar production has come from the use of more fertilizer, better varieties of cane, and the control of pests. About $4,000,000 is spent for fertilizer annually, of which more than half is for Chili nitrates. Entomologists are constantly studying insects and how to control them. In Hawaii the three worst enemies of the cane have proved to be the leaf-hopper, the cane borer, and the Anomala beetle. Parasites of all these have been found so that their ravages are under control. The Tachinid fly from New Guinea was imported as an enemy of the cane borer, a wasp from the Philippines for the Anomala beetle, and several insects to prey on the leaf hopper. Better varieties of cane have also been developed that are higher in sugar content and more resistent to disease. An experiment station, which is maintained by the Sugar Planters Association and the University of Hawaii, has been a great factor in solving the problems that arise in the growing of sugar cane. The yield of the Hawaiian cane fields is the highest in the world. In 1925 the yield from irrigated plantations was 498,121 tons of sugar from 64,595 acres—an average of 7.711 tons per acre, and from unirrigated plantations was 276,267 tons from 56,790 acres—an average of 4.865 tons per acre. It costs less to care for unirrigated cane than for irrigated, but some of the irrigated plantations are among the lowest cost producers per ton of sugar.

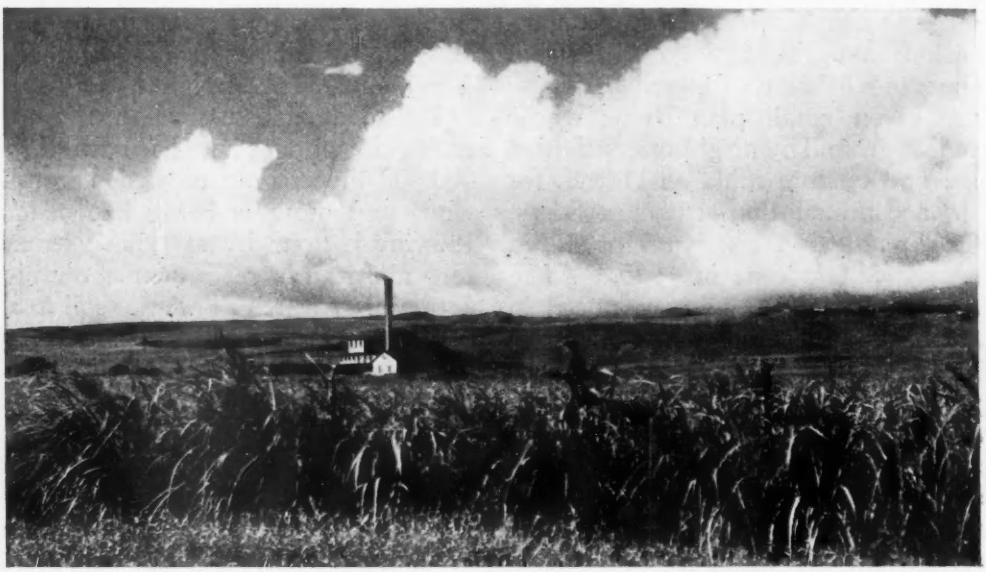

FIGURE 5.—Sugar mill on Oahu. The sugar mills usually grind the cane from one plantation. Around the mill are the homes of the mill and field workers. Each plantation is a separate community, with its own management, mill, and village. (Photo by R. J. Baker, Honolulu.)

Sugar production in Hawaii is favored by: (1) natural conditions of soil and climate that are favorable for the cane and permit it to grow 8 to 10 years without replanting, (2) lay of the land and sources of water that permit of irrigation that makes for maximum and steady yields, (3) introduced laborers, (4) highly efficient management, and (5) the protective tariff which protects the Hawaiian sugar, produced at higher cost than in more truly tropical lands like Java, by a tariff of 2.206 cents on foreign and 1.7648 cents on Cuban. This insures a ready sale of all Hawaiian sugar that can be raised to the markets of the Mainland.

Five commercial firms in Hawaii manage 42 out of 51 plantations and mills and dominate business in the territory. They serve as agents for steamship lines, sell insurance, maintain retail and wholesale stores, and in fact transact the great bulk of the important business of the islands. These firms have been organized for many years and one of them has just celebrated a business of a century. There is no state in the Union where business is so dominated as it is in Hawaii by these five business groups. To them belongs the credit for the wonderful industrial development of the islands and so far they have exercised their power efficiently and well. It is correct to say, however, that Hawaii offers few opportunities for the poor man except as a laborer or small shopkeeper. A few families control most of the land and big businesses.

FIGURE 6.—Newly planted pineapples, on Oahu, showing the paper mulch used in planting, which conserves moisture, keeps down weeds, and saves labor. (Photo by R. J. Baker, Honolulu.)

### PINEAPPLES

The growing and canning of pineapples is the second industry in importance in Hawaii. Pineapples were found growing wild by the European discoverers of the islands, but the commercial fruit of today has been developed from the variety known as the Smooth Cayenne that was introduced in 1888. The first output of canned pineapple was 1,893 cases in 1903. This increased to 8,728,580 cases in 1925 and exceeds 9,000,000 annually now. There are 13 companies canning pineapples in

Hawaii. These mostly grow their own fruit, but some is purchased from small growers. Pineapples are raised commercially on Oahu, Maui, Molokai, Hawaii, Kauai, and Lanai. Oahu produces more than half the fruit, and the largest canneries are at Honolulu where transportation facilities are best. The pineapples grown on Lanai and Molokai are brought to Honolulu on barges for canning.

Pineapples require a warm, mild climate but do not need the large amount of water required by sugar and hence are grown entirely without irrigation. They can be grown on a variety of soils and at higher altitudes than sugar. The fruit is often raised on rough land and steep hillsides adjacent to the cane fields. The higher flow slopes where it is difficult to irrigate up to altitudes of over 2,000 are especially planted to pineapples. In its growth the pineapple industry has utilized chiefly waste land and pasture land that was supporting very few people. The larger plantations have their own villages for workers like the sugar companies. One company in 1925 purchased almost the entire island of Lanai and plans to plant 30,000 acres there to pineapples.

New fields of pineapples are planted with slips and especially with the leafy crowns of the fruit which are thrust through an asphalt paper into ground that has been plowed deeply and is well drained. The paper keeps down weeds and conserves moisture, but insects are beginning to flourish underneath it and the planters are considering replacing the asphalt paper with one that will decay quicker after its purpose is served. A few pineapples ripen throughout the year, but most of them ripen in the summer. The canning season lasts only a few

FIGURE 7.—Mature pineapples. Hawaii supplies canned pineapple to all the world. The crop is raised, without irrigation, on land too rough or too elevated for sugar cane. (Photo by R. J. Baker, Honolulu.)

months. The first crop may take 18 months to mature and each plant bears one large fruit. The second crop a year later is larger as the plants bear two or more fruits apiece. Crops can be gathered annually for 6 to 8 years before replanting is desirable.

The largest pineapple canneries are in Honolulu. One of them, when in operation, has the largest output of any fruit cannery in the world. It employs 2,000 persons and is filled with special machinery for economical, sanitary operation. Much of the machinery has been invented in Hawaii and is of special manufacture. The fruit is not touched by human hands during the process of canning. Tin cans are manufactured in a plant next door to the cannery and are brought on an endless belt for immediate use. Some 200,000,000 cans a year are made. A plant to manufacture special cardboard boxes in which canned pineapples can be shipped is in process of construction.

Hawaii enjoys almost a monopoly of canned pineapple in the world, producing more than 90 per cent of the world's output of that commodity. Twenty-five years ago canned pineapple was an unknown food product. To develop a demand extensive advertising was indulged in, and as the product satisfied the public, the steadily increasing production has usually been readily sold. The Association of Hawaiian Pineapple Canners has been organized to help the industry. It advertises the product and maintains in connection with the University of Hawaii an experimental farm, greenhouse, and laboratory with an extensive staff for the study of pests and soils, as well as the breeding of possible better varieties. Shipments of canned pineapple continue throughout the year and can be carried during the time that sugar shipments are slack. This is a convenience to the transportation companies and aids them in operating their fleet profitably throughout the year.

The pineapple industry in Hawaii has been favored by (1) climate, (2) abundant land better suited for pineapples than for any other salable crop, (3) scientific management and the care used to produce a high quality product from the field to the can, (4) invention of special canning machinery, (5) utilization of by-products as pineapple bran for stock feed and pineapple juice, (6) advertising, (7) available capital, in part made in sugar and other ways in Hawaii, and (8) early start of the industry in Hawaii and resulting high reputation of the product. It is therefore plain that while natural factors are favorable for pineapples in Hawaii, yet the industry would never have developed so extensively if it were not for the human factors.

### GRAINS

Some wheat was formerly grown on the upper mountain slopes of Maui and Hawaii, and considerable corn is grown for stock feed today; yet, rice is the only important grain grown on the islands. For fifty years rice was second in value only to sugar, but the output has greatly declined in the last twenty years. This has resulted from a number of causes among which may be mentioned: (1) backward and careless farming methods, (2) an objection on the part of Japanese to use Hawaiian rice due to its quality, (3) greater remuneration from planting other crops like sugar, and (4) labor difficulties. The methods used in rice growing offer a strong contrast to the plantation methods of a sugar plantation, as the rice is grown in tiny plots, the plants are transplanted by hand, the harvest and threshing are usually done by hand, and there is none of the extensive machinery of the plantations. In 1899 there was a production of 33,480,000 pounds of rice from 10,262 acres; in 1919 the production was 18,254,000 pounds from 5,801 acres. As a result of the decline in rice growing, Hawaii has ceased to export rice or even to grow enough for local consumption, and instead she imports some $3,000,000 worth of the grain annually. Rice is grown only on rich lowlands, principally on Kauai and Oahu, where the ground can easily be flooded. Two crops are grown each year and the industry is capable of considerable expansion, but so long as profits from sugar and pineapples remain large and there is plenty of money to import foodstuffs, it is improbable that the islands will grow all their food, since California rice costs less to produce.

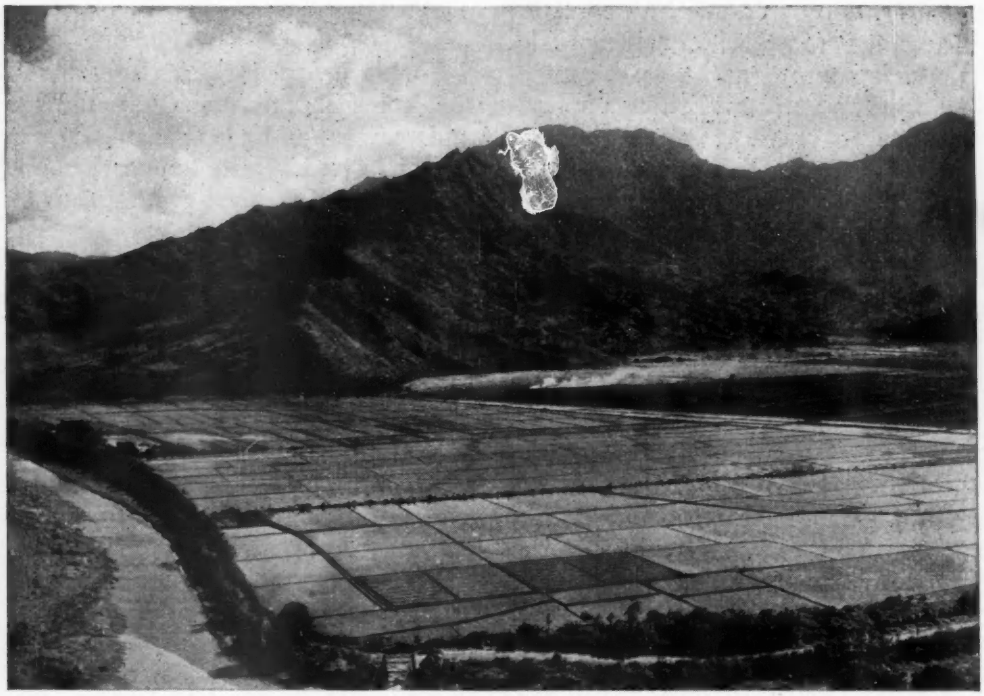

FIGURE 8.—Rice fields on Kauai. Hawaii grows only part of the consumption of the territory, about 4,000,000 pounds being imported from California. Rice is grown by primitive methods in contrast with the efficient plantation machine methods used in growing sugar and pineapples. (Photo by R. J. Baker, Honolulu.)

### COFFEE

Coffee is a fairly important crop in Hawaii and the industry is capable of expansion. For the fiscal year ending June 30, 1926, 3,016,466 pounds of coffee worth $815,044 were exported and more than this was consumed in the territory itself. Coffee is the third industry in value of exports. All of the commercial coffee crop is grown on the island of Hawaii, and the most important region for the crop is the Kona District near the western coast. Coffee grows best at altitudes between 1,000 and 2,500 feet and the trees are often planted on very stony ground, yet they do well. Kona has the freedom from winds, and the soil, climate, and water supply needed for the best type of coffee. Hawaii produces an exceptionably fine flavored coffee that unfortunately is rarely tasted in America. Coffee is grown by independent farmers; there are few plantations devoted to it. Kona coffee has been little advertised. If a strong coöperative association could make its desirable qualities known on the mainland as has been done with Hawaiian pineapple, the industry could be expanded very considerably with much profit to the territory. In 1919 nearly 20,000,000 pounds of coffee were produced and the production has increased since then.

### BANANAS

Bananas are the fifth most important crop in Hawaii and rank fourth in value of exports. In 1926, 257,205 bunches of bananas valued at $253,802 were exported chiefly to California. Both wild and intro-

FIGURE 9.—Coffee trees, Kona District, Hawaii. An excellent grade of mild coffee comes from western Hawaii where soil and climate are ideal for this crop. Most coffee is produced by small growers. (Photo by R. J. Baker, Honolulu.)

duced varieties of bananas grow well in Hawaii. Those exported are mainly the so-called Chinese bananas. Hawaiian bananas are too delicate to stand long shipments inland. Only a few growers on Kauai and Oahu have undertaken the growing of bananas seriously and at least a half of the total crop is consumed within the territory. Bananas from Hawaii face serious competition in Pacific Coast markets with fruit from Central America. In order to expand the industry, which so far as soil and climate are concerned could easily be done, it would be necessary to attract a strong concern like the United Fruit Company with adequate capital, experience, and distribution facilities.

### OTHER CROPS AND FRUITS

Since feed is green the year round in Hawaii, forage crops are of moderate importance. Some alfalfa is raised and more than eight cuttings a year can be secured. Pidgeon peas have been introduced and promise well. Various tropical grasses are grown.

A considerable amount of taro is grown and is mostly consumed in the form of poi by the Hawaiians. Taro is a fleshy root plant that is grown on flooded lands, in mountain valleys, and the coastal plains. It is highly nutritious and a very cheap food.

The climate and soil of Hawaii are very favorable for the growing of all kinds of tropical fruits, and even fruits of the temperate zone can be grown at altitudes of a few thousand feet. Yet, aside from pineapples and bananas, so little other fruit is raised that in 1925, $1,214,988 worth of fruits and nuts were imported mostly from the Pacific Coast. The reasons for this appear to be chiefly (1) greater returns from plantation crops than from small fruit orchards, (2) lack of interest in growing exotic fruits, (3) distance to market, and (4) ravages of insects, many of which have been introduced, like the Mediterranean fruit fly, with disastrous results. The California market is the most convenient but there is no market there for the fruits that the state raises, and some of the best Hawaiian fruits like papayas, mangoes, and avocados do not ship very well. Furthermore, to keep out certain insects not present in California, there is an embargo against many Hawaiian fruits.

The papaya is a very useful and popular fruit in Hawaii. It is known as the tree melon and the flesh is

highly nutritious. The plants are planted ten feet apart in groves and begin bearing at the age of one year and will grow in only fairly good, often stony, soil. They are well suited for the small grower and their production is rapidly increasing. The fruit is unaffected by insects and exports are possible with tough-skinned varieties.

Avocados flourish in Hawaii. The trees grow in almost any soil where there is enough water and protection from winds. If varieties can be developed that will stand shipment to the mainland, the industry is capable of great expansion. Oranges have long been grown in Hawaii, yet the production is inconsiderable in part due to insect ravages. Most oranges are imported from California. Cocoanuts are little grown as a commercial crop, the chief groves being on Kauai and Oahu. They are much used for ornamental purposes in Honolulu. Mangoes, guavas, grapes, and soft-skinned fruits of the temperate zone are grown on a small scale. Specimens of breadfruit and many other fruits and nuts can be found growing, but, as stated previously, the commercial production of fruits in Hawaii is unimportant except for pineapples and bananas.

Among crops that have been tried experimentally in Hawaii so far without commercial success are rubber, sisal, tobacco, and cotton. These can all be grown but, due to high labor costs or other factors, their production is not profitable. A possible industry of future importance is the production of starch from the edible canna.

A considerable amount of garden vegetables is grown, chiefly by Orientals in the neighborhood of Honolulu and on certain large plantations where there is an available market. Some vegetables do very well but others are seriously injured by insects and other pests. As a result many vegetables are imported, the total of such foodstuffs being valued at $1,555,000 in 1926. Only $50,000 worth of vegetables were exported, mostly as supplies to ships. The value of the vegetables grown for sale in Hawaii was hardly half that of the imports. As a result vegetables are scarce and high in price, yet if market gardening were highly profitable, it would seem that more persons would enter the industry. High rents and cost of land, pests and diseases, and competition with other crops for the use of the land, labor troubles, and competition with imports from the Coast are among the troubles of the vegetable grower.

It should be mentioned that imports of foodstuffs from the mainland is not all waste. Such shipments help to keep the ships busy both ways and thereby insure more favorable rates for exports of sugar and canned pineapple than would probably be otherwise possible. On the other hand, the cost of living is higher than it would be if all food were raised on the islands. Yet, if labor were used for food production, it would be scarce and high for plantation crops, and so far the large companies have preferred to import food rather than grow it.

### ANIMAL INDUSTRIES

The grazing lands of the Hawaiian Islands are mostly included in a few large ranches, some of which consist of several hundred thousand acres each. The island of Niihau is devoted to sheep raising but on the whole few sheep are kept and sheep raising is a rather declining industry.

The best grazing lands for cattle are on the upper mountain slopes of the volcanic domes on Hawaii and Maui, although many cattle are also kept on Kauai and Oahu. Some of the dry lowlands are used for grazing especially where the algaroba grows. The number of cattle in 1919 was 128,587 beef cattle and 8,504 milch cows, a total of 137,091. This is almost identical with the total of ten years previous showing that the capacity of the islands for cattle raising has been fully utilized.

Cattle raising in Hawaii is favored by generally green feed throughout the year, a local demand in excess of the supply requiring imports of meat, large areas of fairly good grazing land, absence of cattle diseases and efficient labor, the Hawaiians being natural cowboys. The industry has been hindered by ravages of wild goats that destroyed the grass, by lack of water on otherwise good grazing land that required building expensive pipelines, poor quality of some of the native beef that is now being improved by importing pure-bred breeding stock, and some unproduced plants like the lantana, cactus, and Scotch gorse that injured the natural fodder.

Hawaii does not produce enough dairy products for local consumption by a good deal. The territory imports about $1,250,000 worth of dairy produce from the Pacific Coast each year in addition to much butter from New Zealand. On the mainland there is one dairy cow to four people, but in Hawaii there is only one cow to sixty people. This is in part due to the food habits of the Orientals who use little milk. Milk is high in price as the dairy industry has to compete with quite profitable crops for the use of the land. The chief dairying sections are around Honolulu, as that city provides the only large market for fresh milk and cream. The plantations mostly maintain their own dairies.

Hog raising is increasing in Hawaii but the islands do not yet produce all the pork they consume. More than $1,000,000 worth of pork products are imported from the mainland each year. There are 40,000 pigs in Hawaii, about one pig to eight persons, only one-fourth the average in the mainland. Some pigs are raised by the large ranches but half of them are kept on Oahu where they are fed garbage and by-product foods near Honolulu.

Bees are kept in the islands and there were exports of honey and wax to the mainland worth $114,852 in 1926.

Not enough poultry and eggs are produced in Hawaii to supply the local demand, and a half million dollars' worth are imported annually from the Pacific Coast in addition to some from New Zealand and China. Chicken raising is hindered by the expense of imported feed and by various poultry diseases. Also, the lack of a small independent farming class in the territory certainly holds back the poultry business. The high price for eggs helps to compensate for expensive feed.

### MANUFACTURING

Manufactures in Hawaii are unimportant except for certain things that demand abundant local raw materials of agricultural origin, or for which a local market is available. Without mineral fuels, metals, important water power, or large available markets, the development of general manufactures for export is not to be expected. Sugar milling

and pineapple canning together account for three-fourths of all manufactures and employ 60 per cent of all the wage earners engaged in manufacturing.

Manufactures in Hawaii in general consist of (1) products made from local raw materials for export in order to reduce the weight and thereby save on freight and also make things on which the freight rate for the finished article is higher than for the raw material and for which there is a local market, as tin cans, railroad cars, and sugar mill machinery; and (6) articles like newspapers and other printed matter made from imported materials where the time factor prevents competition from the mainland.

FIGURE 10.—Harbor of Honolulu and the business section of the city. The harbor, at the left, will be enlarged by dredging the Kalihi Channel to the bay at the right to allow room for increased wharfage and industrial development.

them less perishable, *i.e.*, raw sugar and canned pineapple; (2) food products grown locally and mostly used locally that require partial manufacture to fit them for use, as cleaning and polishing rice and coffee and making poi from taro; (3) some perishable and semi-perishable manufactures using mostly imported raw materials to be sold in local markets, as ice, baked goods, candy, and soft drinks; (4) curiosities and curios for which tourists provide the chief market; (5) machinery and other

## TOURISTS

The third business, if it can be so-called, so far as bringing money into the territory is concerned, is the tourist business. Not counting one-day visitors from steamships, some 12,000 tourists came to the Hawaiian Islands in 1926 and it seems probable that they spent several million dollars while there. The tourist business is rapidly increasing and at times is only limited by the steamboat accommodations, and as new ships are

provided further travel can be expected. New hotels have been built at Honolulu and elsewhere to care for the expected increase of visitors. The most popular season is, of course, winter, but there is a second peak in early summer. There are nearly 20,000 soldiers and sailors regularly quartered in Hawaii mostly on Oahu and the amount they spend is of some importance in Honolulu, a city of only 100,000 persons.

### TRANSPORTATION AND COMMUNICATION

Due to the high, steep mountains, road building is somewhat difficult in most parts of Hawaii. Good paved roads, however, are being built and it is possible to drive entirely around Oahu and Hawaii. Roads reach all parts of Maui, Kauai, and Molokai, although, around these islands, roads have not been built due to great cliffs adjoining the sea for miles. Some out-of-the-way sections are only reached by trails, but most parts of the islands can be reached by automobile. High cost of inter-island transport of passengers, automobiles, and general freight somewhat interferes with the traffic on inter-island boats. Airplane service is projected between the islands. Communication with the Pacific Coast by cable and wireless is good, and there is a cable to the Orient also.

There are seven railroads operating on 336.6 miles of track in Hawaii of which 88 miles are standard gauge and the rest narrow gauge. The railroads are located chiefly along the coast and run only short distances inland. In addition 32 plantations operate private railroads totaling about 900 permanent and 300 miles of portable track. On the larger islands, in addition, there are passenger buses and freight trucks operated on schedule. Honolulu is the only city provided with electric street-car service.

Two harbors on Oahu—Honolulu and Pearl Harbor—were the only good natural harbors on the islands. Honolulu Harbor has been well improved and is one of the most modern ports of its population on the Pacific. Pearl Harbor is the Government Naval Base. Artificial harbors that permit the landing of passengers and freight directly on the docks have been constructed at Hilo on Hawaii and Kahului on Maui. There are many other landings where the ships have to anchor some distance from shore and load freight from barges. Honolulu is a port of call for most Trans-Pacific liners from North America to Asia and Australia. It is served by 24 commercial and two military steamship lines, of which 14 are American. Hawaii receives mail from the Pacific Coast about three or four times a week, and less frequently from the Orient and South Seas.

### COASTWISE AND FOREIGN COMMERCE

In addition to inter-island traffic total exports from Hawaiian ports in 1924 were 847,121 tons and imports 845,475 tons. San Francisco received 91 per cent of all exports; Los Angeles was second and Seattle third. About 98 per cent in value of Hawaii's export trade is with the continental United States. For the fiscal year ending June 30, 1926, Hawaiian exports were valued at $104,624,291 of which $102,780,000 was with the mainland, $681,000 with the Philippines and $1,163,000 with foreign countries. The value of exports to chief foreign countries were England $488,000, Canada $338,994 and Japan $112,500. The chief domestic

exports of Hawaii in 1926 were sugar and molasses $70,000,000, pineapples $35,000,000, coffee $800,000, bananas $250,000 and about $500,000 divided between hides and skins, honey and wax, canned tuna, vegetables, and a few other commodities.

Imports are far more varied than exports. Hawaii produces few commodities, and imports almost everything. For the fiscal year ending June 30, 1926, imports were valued at $83,840,000 of which $72,953,000 came from the United States. The chief imports were petroleum products, $8,675,000, tin plate $4,478,000, automobiles and parts $4,354,000, rice $3,700,000, cotton manufactures $3,565,000, breadstuffs, lumber, tobacco, machinery and iron and steel products, books, chemicals, fertilizer, electrical supplies, burlap, fish, fruits, feed, dairy produce, and meats and vegetables. The Philippines sent goods valued at $365,000 and foreign countries $10,478,000 of which the leaders were Japan, $3,521,000; Chili, $2,461,000; British India, $1,543,000; New Zealand, $696,000; Hongkong, $728,000; Australia, $386,000; Germany, $240,000; England, $155,000; and Canada, $22,700. Japan sent coal, textiles, curios, rice, and all kinds of small manufactures; Chili and northern Europe sent fertilizer; India sent burlap; New Zealand and Australia sent dairy produce, eggs, jam, and meats. In fact, due to the location of the Hawaiian Islands at the "Crossroads of the Pacific," foods and useful articles are imported from all points of the compass and the contents of any Honolulu store shows this.

The balance of trade is always heavily in favor of Hawaii. Part of this returns to the mainland in dividends and interest, part is spent for freight and insurance, part in travel and education abroad, and some is sent home by laborers. But the wealth of Hawaii's capitalistic class is steadily increasing and there has begun important exports of capital. The surplus has been mainly invested on the mainland and in the Philippines and Dutch East Indies. Hawaii is becoming an important factor in the development of the Pacific.

# AGRICULTURAL REGIONS OF SOUTH AMERICA

INSTALMENT V

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## THE YUNGAS

A narrow strip, of deep valleys and high mountain spurs, the Yungas stretches from the arid *monte* of nothern Argentina to the major break in the eastern Cordillera just south of the Marañon. Bordered on the east by arid chaco, broad savannas, and dense tropical forest, it extends from true tropical climes at about 2,000 feet to cold areas near 10,000 feet in the Cordillera; from regions of little agriculture through subtropical and temperate valleys of many crops to the cool temperate range land on high mountain slopes. Though facing the broad plains to the east, each valley in addition to local consumption looks to the population of the highlands as a market. Separated from consuming centers to the east by thousands of miles having meagre transport facilities and walled in on the west, few commodities can stand the cost of transportation to distant marts. These include coca extract, cacao beans, cinchona bark, some fruits, hides, and liquors, commodities of high value per unit of weight and bulk. Inhabited by sedentary folk, largely of Indian and mestizo blood, the agricultural ribbons in a province of diverse physical conditions lend unity to the region and set it off as different from bordering lands.

### PHYSICAL CONDITIONS

Few areas of South America exhibit in close juxtaposition such contrasting conditions of relief, soils, climate, and vegetation. In much of the region one may descend in a few hours by steep, winding, treacherous trails from penetrating cold, struggling, highland Indian with his thick-walled hut, cultivated patch of potatoes and *quinoa* and wandering flocks of llamas and sheep to sweltering heat, enervating diseases and insects, and to nomadic forest and Chaco Indian fed by exuberant nature.

Rugged in the extreme, the relief of the region presents few conditions auspicious to agricultural activities. High mountain spurs separate in the upper portion of the region mile-deep canyons, where mule trails cling to precipitous slopes or repeatedly cross rushing streams, and in the lower portion somewhat broader waste-filled valley floors, where the chief farm lands are. For the region as a whole, little level land exists, but a few flat-floored valley basins have considerable extent and contain densely populated districts, as in the Upper Huallaga Valley, Mantaro Valley, Middle Urubamba and its tributaries in Peru, and around Sucre, Cochabamba, Tarija, and Tupiza in Bolivia. Many bare mountain walls support no soils. On the slopes soils vary from thin gray soils in patches in the drier portions to deep brown and red clay soils in more moist areas and on igneous rocks and red shales. These heavy red clay soils resist erosion remarkably even on steep slopes. Everywhere small

and large alluvial fans and valley floors afford soils from almost pure gray gravels and sands in the upper portion, where streams drop their heaviest loads, to dark fine silts and clay on the lower margin of the fans and in the broader valleys below.

While the Yungas stretches through 21° of latitude, the great diversity of climatic conditions results as much from contrasted relief and exposure as from latitudinal extent and migrations of vertical rays of the sun. A combination of all these conditions produces violent contrasts of temperatures and precipitations within short distances.

Well within the tropics, temperatures vary chiefly with altitude and slopes. In the lower margin of the Yungas high temperatures as a rule prevail; summer temperatures range from 77° F. to 95° F. and winter temperatures vary between 56° F. and 72° F.; this region is prevailingly sunny. At intermediate elevations vernal conditions prevail; no unpleasant extremes of either heat or cold occur. The proportion of sunny days is greater than that of cloudy ones. Higher up, from 8,500 to 10,000 feet, temperatures are lower, typical stations having mean annual temperatures of 64° F. or lower; in December 70° to 77° F.; and in June or July 35° F. or below. Prevailingly cloudy and moist, this zone has penetrating temperatures.

The southern position of the region receives between 10 and 40 inches of rain annually and the northern between 20 and 50, although locally exposed slopes may get more and broad deep sheltered valleys may receive less. As much as three-fourths of the precipitation falls in the rainy season from October to May, but local convectional showers may take place even in the driest months. Four rain zones are well marked: the low hot plains of convectional and heavy rains, dry sheltered valleys, floors, or basins in the lee of marginal mountain spurs, the zone of maximum precipitation on exposed slopes 6,000 to 8,500 feet elevation, and a light and varying zone of lighter rains higher up.

FIGURE 77.—A young "V" shaped valley near the upper border of the Yungas in eastern Bolivia. On the narrow shoulder of land above the trail and the river in the center of the picture are the only cultivated patches in the scene. Mists and clouds roll up the valley from the east.

Consequent upon relief, soils, and climatic conditions, vegetation exhibits similar striking contrasts. In the wet hot valleys forest growth is dense and undergrowth luxuriant; a variety of species abounds. On the valley floors and tributary fans shrub growths expand into forest bands along the water courses. In the

deeper, drier valleys and on coarse alluvium xerophytic vegetation including cacti and associated species dominate. On intermediate slopes within the cloudy rain zone, open stands of trees grow by species. Tongues of trees extend up deep valleys, shady ravines and moist slopes to the limit of the Yungas (Fig. 77). The timber line varies vertically more than 2,000 feet in the Yungas owing to conditions of relief, soil, ground, water, sunshine, and winds. The major forest zone of the lower plains is separated from that of the cloudy rainy slopes by drier arborescent types and grasses. Also above 8,500 feet grass-covered slopes dominate the landscape. Slopes in much of the region that receive the noon and afternoon sun for a large part of the year are covered with grasses, shady nooks with trees; change from trees to grasses in many places is so sharply defined that the transition seems to be the artificial edge of cut-over lands.

FIGURE 78.—Coca on terraced slopes before harvest in the Yungas east of La Paz. (Courtesy of the United States Department of Commerce.)

## YUNGAS AGRICULTURE

The marked compression of relief features, soil types, climatic zones, and plant associations provide in the Yungas favorable conditions on restricted scales for almost the whole list of temperate and tropical agricultural products. At the same time these features prohibit the use of much of the land. Only a mere fraction of the area can ever be used. The agricultural lands of the Yungas comprise two distinct types: (1) the lower slopes of deep red soils and the broad waste-filled fertile valley soils, where among a great variety of agricultural products coca, corn, barley, sugar cane, and cacao in the products they supply for trade, occupy an important place commercially, and coffee, many fruits, and various vegetables constitute subsistence products; (2) high pastures, where graze llamas, alpacas, and sheep, and patches on mountain slopes where Indians grow potatoes, barley, and *quinoa*, and the narrow upper valleys of corn, barley, and pasture.

### CROPS

Landowner, tenant, and independent farmer give chief attention to the production of commodities that provide articles which can stand the cost of transport on mule or human porter to the chief markets, the mining camps, and the towns of the bleak highlands. Little interchange takes place between neighboring valleys, since all produce like commodities.

#### *Chiefly Commercial Crops*

Most typical of the Yungas, the coca plant (*Erythroxylon coca*) finds favorable physical conditions, meets the exacting requirements for shipment, enjoys a large market, is widely cultivated, and supplies the basis for the most lucrative business of the region as a whole.

The coca plant grows as a shrub, attaining a height of 5 to 10 feet, though most plants are pruned down to 2 to 3 feet as the smaller bushes yield more tender leaves (Fig. 78). The young plants, produced from seed under a shelter of straw or banana leaves, are transplanted when a year old to terraces about a foot wide, four or six plants to a hill, and are irrigated. Carefully cultivated, but not too much direct sunshine, often cut off during the middle of the day by clouds and mists drifting up the valleys.

After the leaves are picked, they are dried in the sun on earthen or slate floors, pressed into bales varying from 25 to 50 pounds in different regions, and in this concentrated form at 12 to 20 cents a pound, packed on mules or by men to the markets of

FIGURE 79.—On the more gentle slopes and the broader valleys much of the land represents a quilted patchwork of wheat, barley, vegetables, and corn.

at the end of two years the bushes may be picked. Bushes then yield in four pickings from one to two tons of leaves per year for a period of 12 to 18 years.

Coca does best on steep slopes of heavy red clay, but well-drained soils from 2,500 to 6,000 feet elevation, where considerable water comes in the form of rain or is supplied by irrigation. The plant for a large yield of tender leaves requires moist air and fairly high temperatures, 65° to 80°, the highlands, where they are chewed by every Indian more than six or seven years old. From a small part of the crop is extracted in many small factories the alkaloids that move to the northern hemisphere in the form of white cakes to be used as the basis of the anæsthetic cocaine. Packs of leaves are also exported for this purpose.

Corn grown in all parts of the Yungas, except the thin soil areas and cold districts of the higher parts,

clings to the steep slopes and spreads out onto the alluvial soils of the larger valleys (Fig. 79). Planted at intervals of 6 to 10 inches in rows 3 or 4 feet apart, in contrast to coca it receives little attention; seldom plowed it may be hoed once, or possibly twice during the season. In spite of inferior seed and poor methods of tillage, it grows to fair height and is of good quality owing to fertile soil, favorable precipitation, and much sunshine. It fits well into the agricultural economy of the region. Probably two-thirds of the yield for the entire Yungas goes for the manufacture of *chicha*, smaller quantities being used for feed, some for breadstuffs, though few appreciate the value of corn as a diet; some fields are grazed in the drier valleys.

Barley, the chief cereal of the high cold and less fertile lands of the Yungas, occupies a large acreage in the lower parts of the region. Occupying poor dry lands on which other crops do not thrive so well, it fits into the agricultural economy of the region. Almost the entire yield is converted into beer and alcohol, though in drier sections the straw is valuable forage for livestock.

Wheat, one of the leading food crops, is produced in considerable quantity on a variety of soils and on steep mountain slopes as well as in the valleys. Yields average low as with most other crops. Harvested by hand with a sickle, thrashed by driving oxen over the leaves on a stone floor, and winnowed in the wind, it is ground in numerous small mills at the base of mountains, where water from a small stream operates a stone burr (Fig. 80). Despite its widespread culture, the Yungas imports flour.

FIGURE 80.—The flat floors of the broader valleys are well tilled with corn, sugar cane, and wheat; threshing wheat with oxen; tall trees line the water courses.

Sugar, well adapted to fertile alluvial soils, much sunshine, and irrigation where local rains do not suffice, occupies favored positions in valley bottoms and climbs up the lower hot slopes on heavy but well-drained clay soils. Giving fair yields of cane per acre in spite of poor methods, the fields produce three or four crops from one planting. Like corn, it gets little cultivation. The cane ground in

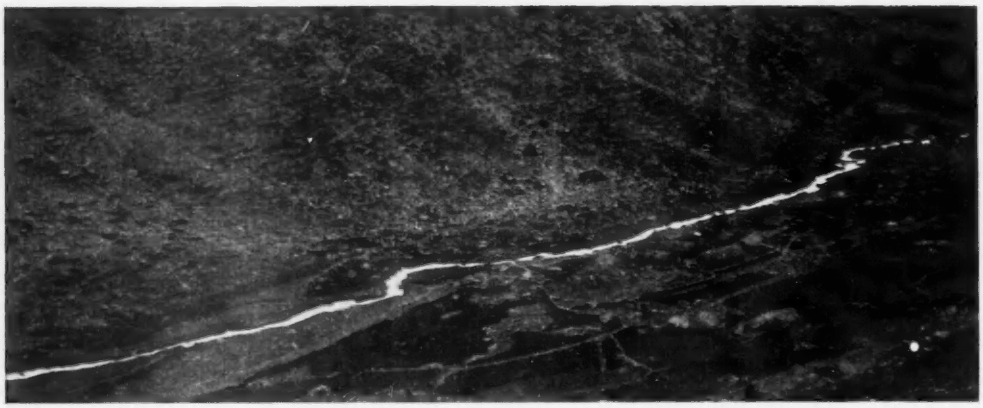

FIGURE 81.—An Indian village in a deep valley near the upper border of the Yungas; patches of potatoes and quinoa, the only crops, spread out in the valley near the huts.

small, crude crushing mills gives a fair quality sugar whitened by means of mud. As with corn most of the crop converted in small "trapiches" into *aguardiente*—brandy—or alcohol, provides commodities of high value per unit of weight and bulk.

Cacao, grown in the lower hot moist margin of the Yungas from 2,000 to 3,200 feet elevation supplies another commodity adapted to the region. Confined to the heavy but well-drained soils and to the hot humid portions, the cacao trees require little care, once they begin to bear, except for weeding now and then and maintaining drainage ditches. Eight to ten-year-old trees may bear a thousand pounds of beans. The beans dried with care, and cracked, yield the cacao seed which is ground by hand on an inclined plane with heavy round stones; then the chocolate worked into cakes, dried, and sewed in air-tight cowhide bags moves to all parts of Bolivia. Little Yungas cacao reaches foreign markets, because of low quality and transport costs.

### *Subsistence Products*

In addition to the preceding crops which supply vital commercial commodities, the Yungas produces a wide range of chiefly subsistence articles. Yet small quantities of many of these move to the chief towns within the region and to highland marts.

Coffee, grown in all parts of the Yungas up to nearly 6,000, is confined to small patches; no large plantations exist. Trees, planted chiefly as hedges along roads and fields, receive no care; they are neither pruned nor shaded. Natives pick ripe, and green, berries from an entire branch with one stroke of the hand. Berries of good size, owing to favorable relief, soil, and climate produce a poor quality coffee with inferior methods of culture and preparation.

A variety of fruits adapted to the Yungas environment is grown in restricted patches up to 6,000 and 7,000 feet elevation. Small vineyards, chiefly irrigated in the drier valleys, yield sweet, small, poor quality grapes all of which are used for wines. Bananas, tangerines, oranges, chirimoyas, and peaches of fair quality grow in response to favoring physical conditions. Fruit trees receive little or no care; pruning and spraying are unknown. Diseases, insect pests, perishability, meagre transport, and remote markets restrict production.

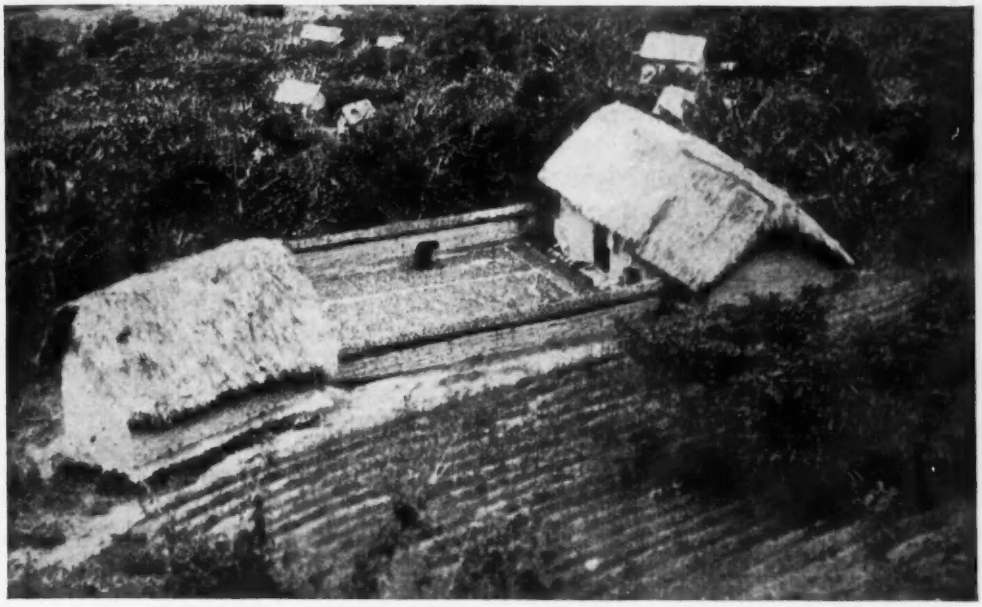

FIGURE 82.—Coca terraces, coca drying floors, and the adobe homes of the permanent laborers on one of the large coca estates of the Yungas. (Photographer unknown.)

As with fruit, a variety of vegetables do well. They include potatoes, yucca, onions, radishes, beets, and others. Potatoes increase in importance from the low dry valleys to the cold high mountain slopes where they become the chief crop, being better adapted to the rigorous climatic and soil conditions than any other crop and yielding comparatively high returns per acre (Fig. 81).

### ANIMALS

As a whole, Yungas agriculture finds small place for animals. In the lower regions, crops cover most of the fertile valley floors and climb high on the slopes, consequently leaving little land for pasture. Also, a forest cover on the moister lands, and zerophytic vegetation on slopes and in stony sheltered valleys, further restrict range lands. Animals in this section consist of draft cattle for use in breaking fields on large estates and of mules for pack transportation. Herds are small, seldom containing more than 200 head. Dairying is little developed, and the meat from the old draft steers is of poor quality. Some goats, pigs, and chickens, "often members of the household" pick up a precarious living. But, in general, this is one area in South America where large numbers of animals do not find a significant place in the agricultural economy of the region. However, higher up on sunny slopes, thin or stony soil areas, and above the timber line in the upper portions of the major rain and cloud zone, good grasses occupy much of the tough mountain land and graze numerous llamas, sheep, and some alpacas. Whereas in the hot valleys the cultivation of crops comes first, here the care of animals becomes the chief concern of the small Indian settlements. As on the great plateaus to the west, from them the Indian derives the major proportion of his meagre necessaries of life.

### LAND TENURE AND LABOR SUPPLY

Nearly all the land of the Yungas is held in large estates by owners, who reside in La Paz and commit the management of the estate to a major-domo. Of vast area, containing as much as 750,000 acres in some cases, the estates usually extend crosswise to the trend of the valley, though some stretch from the lower part of the region to the upper border. They include all types of land—fertile valley floors, naked mountain walls, high pastures, elevated alluvial fans, steep coca slopes, and lowland and highland forests. Each estate, in general, is sufficient unto itself. Each estate must provide almost year-round employment for many permanent laborers and their large families; even small *haciendas* may have as many as 75 to 100 permanent laborers (Fig. 82).

For each one of these permanent laborers, whose low one- or two-room mud or stone houses are provided by the planter, and who receive wages, food, and clothing for regular work on the plantation throughout the year, each estate may have attached to it as many as twenty *faena* or free Indians. The labor of the *faena* is free to the planter. They live in adobe or pole-thatched huts on the high hills or in the margins of the valley floors. They do not own the land they live on and cultivate in small patches. For the privilege of squatting on the land, the Indian pays the landowner in work at the rush harvest season, in a portion of the potatoes, coca, or other crops he grows, or in animals he grazes on the high pastures. In some cases the planter receives money, but in general he prefers labor, since in spite of a fairly dense population, labor is actually scarce.

### AGRICULTURAL METHODS

Though the Yungas has some of the most highly developed agricultural lands in Bolivia and Peru, agricultural methods are extremely primitive, except for coca culture. The Indians, left to themselves, farm as in the days of the Incas. The major-domo often has little, if any, idea of better farming than the ignorant laborer. Should the planter desire to improve methods to procure larger returns, many obstacles stand in the way.

The rugged relief, narrow valley fields, the expense of importation, and the ignorant laborer prohibit the use of modern implements. Moreover, most planters are not anxious to introduce implements that will increase the idle hours of permanent laborers supported on the plantation, or decrease the number of *faena* attached to each estate.

The farmer gets along with the minimum of tools, including a crude wooden plow pointed with steel for scratching the soil, a heavy hoe for chopping weeds and surface cultivation, a machete for clearing out brush and cutting corn and cane, and a sickle for harvesting barley and wheat (Fig. 83). Cane presses, flour mills, and *bodegas* have the crudest of machinery.

Except for coca, most of the crops receive little or no care. The ground is merely scratched. Even corn and cane get only one or two surface cultivations with the hoe. The same crop grows on a piece of land year after year without recourse to fertilizers or rotation. No attempts are made to combat insect pests or diseases.

### THE OUTLOOK

As a whole, little development may be expected in Yungas agriculture for

FIGURE 83.—The chief tillage implement of the farmer of the Yungas, a sharpened stick pointed with steel. (Courtesy of the U. S. Dept. of Commerce.)

a long time. Paucity of level arable land is a major handicap. Steep slopes, though of heavy clay soils, erode under years of cultivation, covering fertile valley soils with sand and sediment, and must be abandoned for new strips on the mountain side. Isolation from the major world markets will continue; Yungas commodities cannot bridge the broad expanse of tropical forest, chaco or fertile plain to the Atlantic; neither can they bear the brunt of high freight rates over the Andean bulks to the Pacific. Expensive and meagre transport even to the adjacent highland market of small buying power deters expansion or improvement.

## CENTRAL ANDEAN CROPS AND GRAZING REGION

Occupying the backbone of the Cordillera from near the southern boundary of Colombia in 2° N. latitude to 24° S. latitude in northwestern Argentina, the Central Andean Crops and Grazing Region presents striking conditions to border lands. From near 9,500 to 10,000 feet elevation on the high slopes of the mountains stretch away to the east the Yungas and the Amazon Forest. On the north, somewhat lower elevations, more precipitation and higher temperature denote a different agricultural economy. On the west flank of the Andes in Ecuador a zone of heavy precipitation produces a tropical district of coffee and cacao, and farther south below 8,500 to 9,000 feet extreme aridity strikingly sets off the Andean zone of pasture and crops not so dependent on irrigation. Though the region extends through 25° of latitude, somewhat similar physical conditions like ethnic groups and types of agricultural economy clearly delimit an important region.

While the region embraces a minor part of the republics through which it stretches, it holds more than half the people of these countries. It exhibits a region of agricultural antiquity. It witnessed the rise of one of the greatest ancient cultures of the Americas. Here Pre-Inca and Inca farmers developed a high order of tillage, terracing the steep slopes, guiding the waters from the high snowfields onto the thirsty terrace, and applying guano and nitrate to the thin stony soils. They evolved certain types of land tenure and methods of tillage that characterize highland agriculture at the present time.

On the whole, the region is one of subsistence agriculture. Except for wool, skins, and a few cattle, little highland produce moves out to bordering lands; on the other hand considerable produce moves into the area from adjacent valleys and lowlands as well as from distant fields. With many physical and economic handicaps the region has had little chance to develop more than mere subsistence farming. Only five railway lines pierce the zone from the Pacific; within, the region depends chiefly upon primitive pack animal

transportation. Nowhere do modern paved automobile roads traverse the area. In addition a backward Indian population burdened with centuries of fixed customs or held in the clutches of a small landholding class barely eke out an existence in the face of exacting and trying physical conditions.

FIGURE 84.—Humid slopes fairly well covered with vegetation in the Rimac Valley, near 9,200 feet. In the foreground alfalfa, low bushy vegetation, and fields of corn typical of the lower portion of the Andean Crops and Grazing Region.

## PHYSICAL CONDITIONS

Everywhere high altitudes and a diversity of relief dominate. Much of the region lies more than 10,000 feet above sea level; many peaks and ridges, crowned with snow and ice, lift their summits well above the zone of crops of any kind and even above summer ranges for the more hardy animals. For much of its length extend two great ranges of the Cordillera—the Western and the Eastern. Between them are high mountain spurs, complex mountain knots, a few deep valleys and the only nearly level lands of the regions, the *Altiplano* of Bolivia, the Upper Cuzco Valley, the Junin and other *pampas* in Peru, and the Quito, Ambato, and Cuenca basins of Ecuador. Though soils vary greatly for the region as a whole they consist of young alluvial soils of sands or sandy loams or piedmont plains on *Altiplano*, *pampas*, or narrow valley floor or thin layers on steep slopes; sandy, gravelly, and stony, they erode rapidly, are low in humus, except portions of the *paramo*, but fairly high in mineral constituents. In some sections, especially in Ecua-

dor, large areas possess a fine to coarse ash material of a highly pumiceous character. In wet areas soils are dark in color; in dry lands they are lighter. In the south the region excloses one of the great areas of interior drainage of the continent; in Peru many streams of Upper Amazon tributaries carve deep valleys far into the Cordillera; in Ecuador many short streams drain narrow rolling valley floors, between 8,500 and 10,000 feet and break through the eastern and western Cordillera.

FIGURE 85.— *Tola* bushes and other shrubs and *ichu* grass on the *Altiplano*, 20 miles east of Eucalyptus.

## CLIMATE

Though well within the tropics, the Central Andean Crops and Grazing Region has temperate climates. Owing to a great diversity of relief, violent contrasts of temperatures exist within short distances. Protected valleys around 8,500 feet possess mild temperate conditions, a mean annual of 65° F. with ranges from 35° to 80° F.; these places seldom experience a frost. On the *Altiplano* or *pampas* from 10,000 to 13,500 feet more rigorous temperatures prevail; a mean annual of 40° to 54° F., a marked daily and seasonal range. Ranges from 28° to 70° F. are common. In the sunshine through the year days are congenially warm; but as soon as the sun sets temperatures drop rapidly. In much of the region between these altitudes freezing temperatures may be experienced throughout the year. The growing season for even the hardier crops is short. On the *Altiplano* the Indians get only one good crop out of four or five seasons owing to frost hazards. On the high *paramo* or the "punas" 14,000 to 16,500 feet only grasses grow; here temperatures frequently drop to zero at night, but for a short period in midday may reach 65° or 70° F. On high ranges and peaks eternal snows and ice fields mark a region of true Arctic climate.

The region as a whole lies in a precipitation zone of from 10 to 40 inches per year. But the northern part, lower both in elevation and latitudes, gets from 40 to 50. Approximately 85 per cent of the precipitation of the region comes between November and March. Local

differences are great; exposed slopes may receive as much as 40, while adjacent deep valleys get practically none; Quito has a rainfall of 45 inches; only a few miles to the north the rainfall is only 15 inches. Differences of altitude show marked contrasts, the heavier rain zone being from 9,000 to 14,000 feet. Snowfalls may be quite heavy on the *paramo* and some of the *pampas*, a few hours of sunshine in dry air quickly dissipating it; virtually the whole of the pasture belt may be grazed for much of the year. The permanent snow line lies from 15,000 to 17,000 feet. Striking variations of precipitation occur from season to season, the rains being so undependable that irrigation is resorted to in many parts of the region.

FIGURE 86.—In the high Paramo 15,800 feet; the llama, the chief pack animal and most important burden carrier of the Central Andes.

### VEGETATION

Consequent upon relief, exposure, soil, temperature, and precipitation, vegetation shows striking contrasts. The lower valleys and slopes up to near 12,000 feet are the only portions of the Central Andean Crops and Grazing Region which support arborescent forms. Here grow the *quishuar*, the mountain ash, a stunted *roble*, hawthorne, masses of yellow-flowered *acacia*, small bamboo, and others. Most associations are mixed; few plants exceed 20 feet in height. Growths line the streams or cling to *quebradas* on the slopes. Here, too, the introduced eucalyptus rears its tall graceful trunk and fluttering foliage far above the low bushy types. Sparse low grasses partially clothe the slopes (Fig. 84).

On the *Altiplano* and higher *pampas*, plant life includes only a few forms. Tree forms have all but disappeared; a few alders may fringe the ravine. Here the surface supports a sparse growth of tall, coarse, bunch *ichu* grass (*Stipa Incana*) and a number of native short grasses of meagre growth, affording the base for much of the pastoral life. In addition to being grazed the *ichu* supplies fuel and thatch for the lowly Indian hut. In moist places *tola* bushes and other low shrubs dominate (Fig. 85). Along the edge of lakes and sluggish streams

grow the tall sedges (*Scripus*), that supply the reeds for the *bolsas;* cattle also graze on the tender tops. In this area as well as in the *paramo* the *llareta* (*Azorella umbelliferae*), a mossy woody growth one to five feet in diameter and growing on bare rocks, furnishes a valuable supply of fuel, after being dried for months. Of value also is the *maguey* (*Agave Americana*) used for cordage, sandals, and other articles.

In the *paramo*, *ichu* and other bunch grasses afford scant pasturage on the thin soil and stony areas; in moister terrane short grasses, mosses, dandelions, buttercups, and many other flowering plants cover the ground. A few low thorny shrubs, especially the *chuquirahua*, struggle against the cold (Fig. 86).

## AGRICULTURE

Though the Andean Highlands have been known for centuries for their mineral wealth, most of the people of the region are closely bound to the cultivated patches or the pastures which give them and their animals sustenance. Contrasted relief, altitude, soils, temperatures, and precipitation produce a variety of crops and different pastoral adjustments within short distances.

### CROPS

The region produces a variety of temperate cereals, vegetables, and fruits; they represent a zonal distribution resulting primarily from differences of temperature with altitude. The lower mild temperate valleys and slopes from 8,500 to 11,000 feet grow the variety of produce; the *Altiplano* and high *pampas* support only four or five crops; the rigorous climatic conditions of the *paramo* prohibit the production of crops at these incredible altitudes—14,000 to 16,500 feet.

The mild valleys and slopes, with considerable sunshine, fair amount of rainfall, much water for irrigation, fairly friable soils of generally low fertility, are checkered patchworks of cereals, vegetables, and fruits. The cereals and vegetables grow throughout these altitudes and occupy much of the land to the exclusion of pastures, but the fruits which include only apples, pears, cherries, and chirimoyas, and which are slightly cultivated in a desultory fashion drop out at the middle altitudes. In general, the fruits grow not in orchards but in hedges along the roads, or streams, and around cultivated patches.

Indigenous to these valleys, corn grows up to 11,000 feet; it does well on rough and stony land, where other cereals yield considerably less. Yields are variable owing to the great variety of growing conditions. Corn supplies a variety of products, food for man, feed for beast, and *chicha* for the lower classes.

Grown throughout the valleys and on the *pampas* to 13,000 feet, wheat becomes the chief bread cereal of the people at middle altitudes. Here it occupies much of the land in the valley floors and climbs high on the steep mountain sides. It has been a staple food since 1535. It finds fairly auspicious conditions for its culture. In some sections wheat grows as a winter crop; in others as a summer crop. Regions of good precipitation account for the bulk of the yield, but considerable is grown under irrigation. In general the planting season extends from October to December; the harvest from June to August.

Essentially a highland temperate crop, barley, although grown in all

the lower valleys, replaces corn and wheat on the *Altiplano* and high *pampas*, where low temperatures, danger from frost, lack of sunshine, and the stony piedmont soils, or damp cold soils prevent tillage of wheat and corn; here it becomes one of the three dominant crops, occupying a large part of the land under tillage. It does not mature any too well under rigorous conditions, but in sheltered mountain nooks it grows at altitudes up to 14,000 feet. It yields well on poor lands and while it can withstand the cold and droughts of the windswept *pampas*, much of the crop is cut green for want of ripening sunshine.

Growing in the mild valleys where it occupies a minor rôle among the crops, *quinoa* (*Chenopodium quinoa*), a small grain largely consumed by highland Indian as well as by white people, finds its chief areas of culture on the bleak *pampas* from 12,000 to 14,000 feet elevation. In patches it even rims the lower portions of the barren *paramo*. Thriving well on stony soils and enduring the rigorous climatic conditions, it stands with barley and potatoes as the major crops of the *Altiplano* and the *pampas*. *Quinoa* closely resembles the dock weed. In general it grows from 2 to 4 feet tall, bearing varied colored leaves and producing white to brown seeds the size of mustard seed. The plant serves a number of uses; the young and tender leaves flavor soups and stews; stems and coarse leaves, reduced to ashes, are chewed with coca leaves; the seeds are used for making porridge, soups, or for flour made in a primitive fashion; the flour with water is baked into a hard bread that is nourishing and has wonderful keeping qualities.

The vegetables grown in the lower parts of the region include a great variety, but on the high pampas they are restricted to three root crops. The valley regions produce cassava, onions, cabbages, tomatoes, peas, beans, and others, but the Irish potato, indigenous to this region, is the chief vegetable here as well as on the *pampas* (Fig. 87). Produced only in small patches, vegetables yield much food and do not occupy much land.

FIGURE 87.—Vegetables of many varieties are grown in the lower portions of the Andean Crops and Grazing Region; a market at Oroya, Peru.

Potatoes, almost the staff of life for the Highland Indian for centuries, are the chief crop on the *Altiplano* and *pampas*. Though not so nutritious as cereals, they endure the low temperatures of these lands, give a fairly good yield per acre on stony soil, and supply the starch food so vital to life in this almost fuelless cold region. The potato grows in sheltered places as high as 14,500 feet above sea level in parts of the region (Fig. 88). It will endure some frost and produce where most crops fail. Owing to the frost hazard only one good crop is harvested in four or five seasons. Many varieties are

FIGURE 88.—Patches of potatoes growing at 14,300 feet on the slopes at a 35° angle. The light colored patches are areas previously planted to potatoes from which the soils have been eroded.

tilled;[1] but most of them are small, rough, fine-textured and varied in color, yellow being the common color of the meat. Much of the yield is used in the form of *chuno* made by drying in the sun and wind, freezing on the ground at night, soaking in water for two months until they become soft, and then dried again. In this form they will keep for years, tiding the population over a bad crop year.

On the pampas and high slopes, two other native tubers replace potatoes in many districts. *Oca* and *olluca*, significant food crops, do fairly well above 14,000 feet and at low temperatures. Like the Irish potato, they supply starch and supplement the meagre diet of the undernourished Indian.

### THE GRAZING INDUSTRY

As a rule the Highland Indian is fundamentally pastoral as well as agricultural; he must be self-sufficient to a large degree. Though various animals, in consequence of widespread forage, may be grazed upon most highland areas not occupied by crops or covered with salt plains, snowfields and ice caps, the ranges fall into three distinct types. They embrace (1) the alfalfa pastures in the valleys, fallow lands on the slopes and mountain ridges above the tilled fields bordering the valleys, (2) the drier portions and swampy tracts of the *Altiplano* and *pampas*, and (3) the cold, raw, damp *paramo*, where grazing constitutes the only occupation.

The valleys and adjacent slopes support the greatest variety of animals—cattle, mules, pigs, sheep, and llamas—grazed on stone-fenced enclosures or on high slopes in care of a shepherd. The animals go to the pastures each day and return at night to the stone corral. Here, grazing supplements crop production; it is not the chief concern of the inhabitant. Herds and flocks include smaller numbers of animals than on the other ranges. This lower range consists of stony rough mountain land, whose carrying capacity aver-

[1] Ballivan, M. V., and Tovar, W. C., in *Noticia historia y clasificacion de la papa de Bolivia*, La Paz 1914, list 184 distinct varieties.

ages about one cow to nine acres.[2] Mules are raised chiefly for pack animals and for distribution to mining centers. Cattle constitute the chief animals; each Indian family cares for a few cows and steers, some considerable milk being used in this zone. Steers and bulls serve chiefly as a meat supply as on the steep mountain slopes few can be used for tillage; this is the zone of foot-plow agriculture. As in other parts of the highland the cattle are of low grade, descendants for the most part of old creole stock. Long-horned, tall, bony, and slaughtered in poor flesh, the steers cannot yield prime meat. Swine and many chickens often tethered by children supplement the food supply.

On the middle range of the broad windswept *Altiplano* and *pampas*, different conditions prevail. Scattered tufts of *ichu* and other bunch grasses and individual spears of short grasses springing up after each period of rains afford a carrying capacity of about one cow to seven acres; many areas poorly watered suffer from droughts that cause considerable losses. Most of the animals of the highland region are supported by the middle ranges. Here, individual ranges include vast areas; separate flocks and herds number thousands of animals. For many Indian families the care of the animals becomes the chief concern of the inhabitant; tillage of the soil often secondary. Animals always graze under the care or eye of a shepherd man, boy, or woman, who invariably spins yarn while tending the flock. Though herding many animals belonging to the *hacienda* flock, each family possesses a small number, inherited, bought, or stolen. Cattle become the chief draft animals for breaking the ground with a wooden plow pointed with steel and

FIGURE 89.—A flock of medium-grade sheep in the Junin Pampa of Peru; in the foreground *ichu* grass.

[2] Five to six sheep equal one cow; six to seven llamas equal one cow; four to five alpacas equal one cow.

for drawing heavy loads. The plateau Indians use little milk, but they eat considerable meat. Many cattle, pigs, and chickens are tended, but sheep, llamas, and alpacas constitute the chief animals.

Sheep, though consisting primarily of old degenerated merino breeds, constitute a fundamental basis of existence for the Highland Indian. Flocks, varying in size from a few to several thousand, contain sheep of many colors, from black to white. Low temperatures favor the growth of a good quality wool, and the absence of burr and prong-bearing seed plants renders the clip free of foreign material, yet the wool does not rank high owing largely to inferior breeds of sheep, and methods of shearing, baling, and shipping (Fig. 89).

Of more importance to the Indian is the llama, a handsome, docile animal that finds a place among the flocks of every family. Grazed in large numbers on the *Altiplano* and high *pampas*, the animals, indigenous to this region, find the conditions to which they are suited: cold, windy, moist, and cloudy lands covered with *ichu*, short grasses and *tola* bushes. The llama is vital to the Indian; it clothes the Indian with its wool; it provides tools and utensils from its bones; it gives light from its fat, fuel from manure carefully gathered and dried, drum heads for feast days and leather straps for pack harness and saddle; and finally, after spending a life as a beast of burden, making the fortune of its master, or when it accidently falls over a cliff and breaks a leg or its neck, it supplies meat for the underfed Indian. The wool is coarse and heavy and does not enter export trade, but the pelt provides the only bedding the Indian possesses.

Often herded with sheep and llamas, the alpaca in large numbers supply a wool much superior to those animals. A considerable portion of the wool moving out of this highland region consists of alpaca wool. It is long in fiber and fine in texture and from jet black to pure white in color, being adapted for use in very fine high-grade goods; the pelts often serve as high-priced rugs or bedspreads. The alpaca, somewhat smaller than the llama, does not serve as a burden bearer. Only partially domesticated, its chief habitat consists of the cold solitary mountain recesses, grazing on the short grasses of the high altitudes near the snow line. It requires better pasture than the llama; for it pure water is essential, it being unable to go without water as the camel-like llama. Sheared once in two to five years, they yield large fleeces (Fig. 90).

Above the *Altiplano* and the high *pampas* stretches to the snowfields and the snowcapped peaks, the cold damp windswept *paramo*, the land of the nomadic herder. Through little frequented lofty valleys, over bold slopes, and into the biting winds off the snowfields the scantily clad, often barefoot, Indian herder drives his flocks for days in search of forage, often without food save for *quinoa* "pone" cold meat, *chicha* and the stimulating leaves of coca, and without water for a day or more at a time; far from shelter he camps where night overtakes him. In general the *paramo* lands are attached to some vast *hacienda* with headquarters on the *Altiplano* or pampas, though vast high areas are open to all who wander in that direction. Especially heavy migrations take place to the *paramo* with each season and each overgrazing of the scant forage on the adjacent ranges below.

FIGURE 90.—Llamas grazing on the high snow-covered Paramo.

In the entire region and for the grazing industry as a whole, no modern methods exist. Entirely in the hands of the Indians, there is no system of stock breeding. Sheep, llamas, and alpacas are herded together in most areas, giving rise to many crossbreeds with varied colored wools of many grades. Migrating from range to range, pastures are often overgrazed. The animals are sheared from one to five years with pieces of sharpened stone, in general, instead of with modern clippers.

## LAND TENURE

Three types of land tenure prevail in the Central Andean Crops and Grazing Region. They include (1) the primitive communal holdings, (2) the vast estates or *haciendas* created by the Spaniards and still owned by families of European or Mestizo blood, and (3) the holdings of the *colonos* or peons who live on the vast estates on a given piece of land; though they do not actually own the land, they are as fixed to the land as the land itself to the estate.

From time immemorial the community Indians have zealously guarded their parcels of land. The Indians carefully guard the stones that delimit their holdings. They are fixed to the soil; nothing will induce them to move. To them their lands have meant freedom from serfdom; they have meant life itself. The community Indians by virtue of independence supplement farming and grazing by fishing, transportation, and employment in the mines or in construction gangs.

The lands held in common consist of three types: (1) the grazing land free to all members of the community upon which the common flocks are herded by the shepherd of the community; (2) the agricultural land, annually distributed among heads of families; and (3) the individual holding of the plot of ground, upon which the hut and stone corral stand held by each family as private property. In the yearly allotment of land each family head receives about 2½ acres often divided into three parts widely separated and including a parcel of the best rich valley soil, medium quality land up on the slopes and poor land high on the ridges. This distribution serves two purposes: it treats every family of the community alike and increased somewhat the variety of products the family could produce (Fig. 91).

Though including much of the land of the region during Inca days, the area and number of communal holdings have decreased materially as a

FIGURE 91.—The cultivated patches of Community Indians extending high up the slopes back of an Indian village near Lake Titicaca.

result of the land hunger of the colonial Spaniard, the ruthless method of establishing huge estates during the long colonial period, and the repeated attempts of the Republic to break up the clan organization of Indian society inherited in the community system and to bring the individual Indian more under the influence of central power and taxes. Consequently, community holdings today lie in the remote sections of the highland, away from the large towns and routes of travel, in deep isolated valleys, around the high mountains on a small piedmont slope or inaccessible ridge, and out on the edges of the windswept *Altiplano* and *pampas*. In general they comprise the lands of least value for crops or pasture. They embrace the thin stony soil areas, salt plains, poorly drained *pampas*, and tiny pockets at elevated valley mouths.

In contrast, the vast land holdings, the great *haciendas*, which include most of the land of the region, cover the better soil areas of the rich valley floor, the easily irrigated alluvial plain or piedmont, the milder valleys more adapted to Europeans and the more verdant pastures of the *pampas* and the *paramo*. The organization of the *hacienda* is simple; the proprietor seldom lives on land; its management is left to a major-domo; he operates the estate according to instructions from the owner, who may visit the *hacienda* only at seeding and harvest time. The laborers consist of *colonos* or *peons* who are bound to the estates by traditions and by the fact that they stick to *their lands* taken into the estate by one means or another, and of free Indians unattached to the soil. The *colonos* will not leave the land to which they have been attached for generations. For living on *his own land*, within the confines of a large estate, the *colono* must render service to the land owner, chiefly in the cultivation of the estate lands, in caring for a large number of the *hacienda*

flock, and in special labor as occasion requires. For this "enforced" service the *colono* receives a plot of land, usually about 1¾ acres, reallotted from season to season according to the requirements of the system of farming for the whole estate, and grazes his own sheep, llamas, or alpacas with the estate flocks under his care.

Embracing vast areas, some of the large estates extend from the lower border of the region to the snow line and beyond, including all types of farm and pasture lands. These *haciendas*, through large returns per family or owner, and through the relation of landlord to *peon* vitally affect agricultural methods and crop returns.

FIGURE 92.—Indian women dropping potatoes, the most important crop on the *Altiplano* and Pampas, in furrows made by the men with the crude crooked sticks for plows.

### AGRICULTURAL METHODS AND CROP YIELDS

Considerable tilled areas and pasture land are irrigated with painstaking care, the Indians being expert at diverting water high up the mountains and directing it around slopes and across ravines to the fields below, but little in the way of modern agricultural methods exist in the entire region. Both physical factors and methods of land tenure combine to enforce primitive culture. In many districts, steep terraced slopes, too steep or difficult of access for even a bullock-drawn plow, restrict tillage to hand and foot methods; throughout the region are scattered the rather densely populated districts of "foot-plow" agriculture. Stony areas, small fields, permanent irrigation ditches, and rough surfaces all but preclude the employment of modern implements. The uneducated Indian, who often finds it difficult to manage a bullock attached to a crooked stick pointed with steel for a plow, could not manage, without long apprenticeship, more complicated machines (Fig. 92). Were methods improved and production increased most districts, isolated and without good transport, could not market the surplus at a profit. In addition, the large land

owner, who receives a comfortable income from even a poorly farmed estate, does not welcome the expense of better methods, and modern machinery to increase the output which he cannot market at a profit and at the same time to break up the feudal system of *peon* labor, wherein lies his chief wealth.

Poorly prepared for crops, the soil receives little tillage while the crops grow. Corn, potatoes, and *quinoa* may be hoed once or twice and ridged up to conserve moisture. Crude harvesting methods are the rule. Wheat cut with hand sickle, treaded from the sheaves, and winnowed by the wind is ground on hand burrs or by small mills operated by water power. Potatoes dug by hand are carefully sorted and prepared. *Quinoa* seeds picked by hand are ground with mortar and pestle.

Combined with these crude methods, uncertain precipitation, low temperatures, almost constant danger from frost, stony infertile soils, lack of crop rotation or the application of fertilizer to the impoverished soils, low yields inevitably result. The farmer is too poor to buy guano or nitrate to fertilize the soil, and animal refuse, laboriously gathered and dried, is more valuable for cooking in this fuel-starved land than for fertilizer. Though no system of crop rotation is in vogue the low fertility of the soils has led to general systems of fallow lands throughout the region. On community holdings, as well as on large estates, the Indian tills about one-fourth to one-eighth of his allotted area each year, the other portions chiefly lying idle or being run over by the animals, that pick most vegetation soon after it comes through the resting soil. In addition to lying fallow some land is improved by growing alfalfa, beans, peas, and the lupine called *choco*.

### TRENDS

Despite repeated attempts by government agencies to improve the agriculture of the Central Andean Crops and Grazing Region, little or no expansion has resulted. In the face of all attempts at improvement lies the lack of transport facilities and the absolute inability to market surplus produce. Though many fairly fertile spots of the region have scarcely been touched and good ranges in remote corners seldom feel the trod of hungry beast, accessible areas have been overtilled and overgrazed. Some increase in production could be accomplished by more intensive use of crop rotation; but these improvements, if realized at all, will come slowly. Crop production, hobbled by rigorous physical conditions and inherited social and economic institutions promises negligible evolution.

The sheep and alpaca industries, despite capabilities of far greater development, face conditions that preclude any marked growth in the near future. The losses of animals, owing to internal parasites, foxes, mountain lions, and condors, are very heavy, yet nothing is done by the Indian shepherds to prevent these ravages. The pasturage during the winter months is inadequate and of poor quality, because, most of the *haciendas* not being fenced, the sheep graze over the whole farm throughout the year, thus preventing the grass from obtaining a good start during the summer. As long as the industries rest largely in the hands of the Indian shepherd, who knows practically nothing about improved methods of breeding, who can neither

read nor write, who speaks only an Indian tongue, and who seems content with the wretched conditions of life, little or nothing can be done to improve conditions.

## PERUVIAN IRRIGATED COASTAL VALLEYS

In practically a rainless region, the Peruvian Irrigated Coastal Valleys, at varying intervals, in a latitudinal extent of 1,200 miles, extend threadlike from the barren coast line to the western flank of the Andes around 8,500 to 9,000 feet, where small but certain rains provide moisture for pasture and crops without irrigation. The irrigated oases constitute the most important agricultural region of Peru. They yield two of the leading exports of the republic and many subsistence products adapted in several respects to the desert environment.

### RELIEF AND SOILS

Deeply entrenched in the broad pampas or between steep mountain spurs, the large valleys have been cut by snow-fed streams and later partly filled; deep alluvium covers the valley floors and abuts with striking sharpness the bordering cliffs. Rather extensive flats provide easy cultivation.

Fifty-two rivers cross the coastal desert (Fig. 93). Only one rises beyond the western Cordillera; many, which have their sources high in the Andes flow throughout the year, although most of them become very low during the dry season; many, not more than small creeks, become raging torrents with infrequent heavy rains in the lower foothills.

The coastal valley soils, generally quite deep, possess excellent texture, and good natural drainage, owing to

FIGURE 93.—Fifty-two short rivers bring from the Andes the waters for the irrigated valleys.

the fact that most of them are superimposed on permeable strata of sand or gravel. In general, the soils are easy to work.

The physical and chemical composition of these soils varies with the nature of the rocks over which the streams forming them have flowed, the slope of the rivers, and the formed land. The proportions of sand and clay are variable in the different valleys and the cohesion and permeability of the soil vary also within wide limits. All classes of soils occur in the several valleys, from compact and humid ones of almost pure clay, through loams and sandy loams to almost pure sand. The more gravelly, stony, and least moisture-retaining soils lie in the upper parts of the valleys, while the more alkaline ones are encountered in the lower sections, owing to less efficient natural drainage and to the accumulation of alkali salts in the waters of filtration.

The thickness of the top soil is greatest in the lower parts of the valleys where it occasionally reaches several feet. The subsoils vary both in physical and chemical conditions; the stony, gravelly, and sandy subsoils show well-drained and porous top soils above them, whereas the more impermeable subsoils, particularly in the case of shallow top soils, show the more humid and poorer-drained types superimposed upon them.

### CLIMATE

Though well within the tropics the temperatures of the irrigated coastal valleys are not excessively hot. Mean monthly temperatures for most desert stations average between 59° F. and 77° F. There are two well-defined seasons: a cool one from June to November and a hot one for the remaining months. As in most desert regions, temperatures vary greatly from day to night, the largest ranges taking place in the hotter months.

Classed as one of the driest deserts of the world, the region is not without precipitation. Yet, the entire area gets less than ten inches per year. Four strips are pronounced: (1) immediate coastal terraces and lower slopes without rains; (2) the upper slopes of the coastal hills rather constantly enveloped in fog and mists, and receiving from one to eight inches of rain per year in irregular infrequent showers; (3) the valleys, ridges, and pampas, a bright sunny area occupying much of the region and receiving rain only at intervals of many years; and (4) the zone of steep valleys on the inner margin of the desert, where small but yearly rains beget a verdant landscape in contrast to adjacent nude stretches to the west.

### FLORA

Consequent upon high temperatures, low precipitation, and desiccation, vegetal growth is sparse and meagre. Treeless, except for the algarrobas of Piura and the inner valleys, and for exotic species in towns and irrigated valleys, much of the area consists of sandy stretches devoid of plant life, even of cacti. A sparse growth of grasses and the *guishar*, a lowly desert tree, appear in the fog belt on the seaward slopes of the Coast Range and in the inner valleys around 7,000 to 8,000 feet. Avoiding the parched desert wastes, plants, animals, and man tenaciously cling to the valleys with their refreshing and life-giving waters.

### AGRICULTURE

The irrigated strips totalling some 650,000 acres amount to only 16 per cent of the farm lands of the country, but they yield nearly half the agricultural produce of the nation. They furnish the chief raw materials for the factories of the region and provide nearly half the total exports of the republic. Except for mere patches they consist of artificially watered lands.

### IRRIGATION

Upon the life-giving waters of the fifty-two short streams that descend from the Andes the farmer completely depends. The irrigated valleys extend along the whole coast, but are more numerous and larger north of latitude 14° S., owing to the greater supply of water from the more rainy Andes of the northern portion.

The many small waste-filled valleys and alluvial fans favor an easy distribution of water from the stream

as they issue from the deep mountain valleys. Irrigation systems are crude and simple. Facilities consist of gravity canals of dirt and usually are lined with trees and other vegetation. Each plantation or field in the highest part has the *acequia madre*, or mother ditch, from which radiate the secondary canals carrying the water to the various smaller fields, called *cuarteles*, and thence down the rows or middles. The excess water from the furrows collects at the lower end for re-use in fields at a lower level. Remarkable efficiency in laying out irrigation ditches, and in directing the flow of water makes possible the irrigation of large areas of land with a small number of *peons*.

The quantity of water applied to fields varies with the location of the valley, the type of soil, the time of the year, and the age of the fields and the crops. Applications of water are most frequent during the summer, corresponding to the period of flood waters in the streams, of great evaporation, and rapid growth of crops. It is almost impossible to calculate the amount of water used per acre or per crop as few *haciendas* have any actual measuring device or weir.

The amount of cultivated land is limited only by the quantity of irrigation water available. The valleys of Santa and of Tambo are two exceptions to this rule, for some water generally flows into the sea the year round from the streams watering these valleys. Fortunately, abundant water and high temperatures coincide, inducing a rapid development of plants during the flood season. Much water of the Andean reservoir goes to waste; during the flood season millions of cubic feet flow unutilized to the Pacific.

On account of the lay of the land, drainage is not a serious problem in general except on the lower, heavier lands where in some exceptional cases tile drainage gives fine results.

### LAND TENURE

Many of the large *haciendas* of the coastal desert originating in the sixteenth and seventeenth centuries are still held intact. Plantations vary from a few hundred acres to seven thousand or more. Large areas in many ways favor irrigation agriculture. The passing of old families of estate holders, the selling of legacies, and the leasing of their properties by widows of *haciendados*, gradually centralized the management of contiguous areas. Ordinarily the breaking-up of huge estates would be considered in most countries a healthy economic situation, but conditions are such in Peru that the opposite process seems likely to continue for some time to come, although the advantages of this system in the long run are doubtful.

### FARM LABOR

Laborers usually live on the estates and are given a piece of land of their own to cultivate in addition to rations and regular wages of 58 to 75 cents for the days they work for the owners. The deficient labor supply on the coast makes it necessary for the planters to contract for Indians from the mountains during the busy season. These Indians usually are good workmen; while labor agitators have at times caused considerable trouble for both them and the plantation owners, most strikes and riots are due to dissatisfaction arising from faulty management on the part of the plantation administrators.

METHODS OF CULTIVATION

Cultivation varies from the crude methods of past times on small mixed holdings to modern on some of the large estates. On the larger estates, after the land is thoroughly cleaned, it is plowed with the Fowler stationary steam engines, which pull the plows along by means of a cable rolled on a drum underneath the

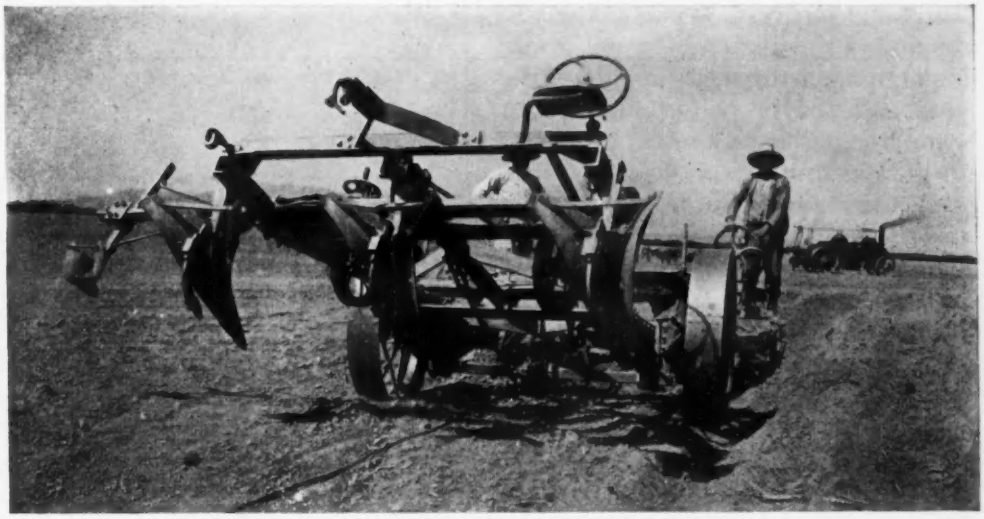

FIGURE 94.—The broad flat or gently sloping lands of the waste-filled valleys afford excellent conditions for the use of large modern implements, such as the double three-bottom plows drawn by steam engines.

locomotive. These engines may be placed as far apart as six hundred yards and do remarkably efficient work (Fig. 94).

Three deep plowings, with the stationary engines, tractors, or bull plows, followed by harrows and a cross harrowing, leave the fields in an excellent condition for planting. A generous application of guano, received by the farmers at a price based on chemical analysis of the product through regulation of the *Compania Administradora del Guano*, to most fields gives good results. In recent years much has been done to combat the ravages of insect pests and diseases for the chief crops.

CROPS

The irrigated valleys yield two great commercial crops, cotton and sugar, and a host of subsistence products, including corn, rice, wheat, barley, alfalfa, many vegetables, and numerous tropical and subtropical fruits.

*Cotton*

Cotton, indigenous to Peru, has made striking progress during the last 25 years. With a production well under 40,000 bales in 1900, the present output exceeds 180,000 bales. Cotton is more widely distributed than the sugar production, as it requires less capital, and finds a place on big sugar estates as well as on many small holdings, growing cotton exclusively.

Thirty-five valleys are engaged in the production of the commercial crop, but the bulk of it grows in ten

small valleys. Three fairly well-defined districts—the Piura and Chira River Valleys in the department of Piura, the central coast region from Chimbote to Ica, and the southern region—account for about 130,000 bales, or 75 per cent of the total output (Fig. 95).

Climate in most of the coastal belt favors a large yield of good-quality cotton. No hail injures the growing boll, no rain discolors the ripening fiber, and no frosts injure the development of the plant. The uniformly high temperatures throughout the year and the proper application of water to the heavily fertilized earth, afford optimum conditions. Also, while the region is not free from pests and diseases, the dry atmosphere hinders development. Insect pests and diseases that do considerable damage include the Peruvian square weevil (*Anthonomus vestutis*), the cotton stainer (*Dysdereus*), the Peruvian cotton worm (*Anomis* sp.), the white scale (*Hemichionaspis miner*), and the cotton wilt.

As a result of favorable conditions, Peru, even with only fair methods of cultivation and poor machinery, produces high yields of cotton of good grade. The per-acre yield of cotton averages more than that of the United States, and ranks well with that of the other leading cotton countries of the world. Since two or three crops can be obtained from the planting, and in some places five with a generous use of fertilizer, a general renewal of the fields does not occur each year and planting coincides with the available water supply. The picking season is neither sharply defined nor uniform. While the peak of the harvest extends from April to July, picking takes place on one valley or another throughout the year,

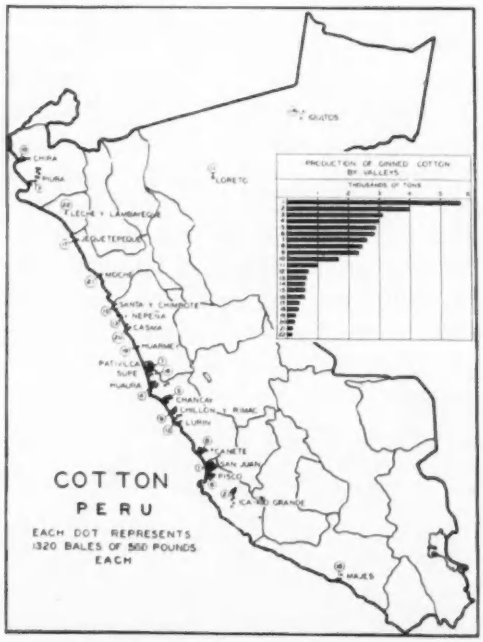


FIGURE 95.—Three districts, (1) the Piura and Chira River valleys, (2) the central district (Chimbote to Ica), and (3) the southern, account for about 75 per cent of the cotton of Peru.

affording a rather uniform movement of cotton.

Several varieties, each of which has a number of grades, enjoy a considerable demand in the markets. The "Peruvian full rough" (*aspero*), with a long and very rough, crinkly fiber, mixes well with wool in textiles. *Mitafifi*, a variety with a long, cream-colored silky fiber, is especially suitable for the manufacture of automobile tires. *Tanguis* has a white and long fiber in both rough and smooth grades, and gives yields from 25 to 30 per cent greater than any other variety; it constitutes about 75 per cent of the total Peruvian crop (Fig. 96).

Cotton in Peru, like sugar, is primarily an export crop, approximately 90 per cent of the production going to foreign markets. Although the exports have registered a remarkable growth in recent years the increase

during the next few years probably will be relatively small. An increase in the output depends upon a greater acreage with more irrigation facilities, better means of combating the Peruvian square weevil, the cotton stainer, the cotton worm, and the white scale, and an extension of wilt-resistant *Tanguis* cotton.

### *Sugar*

Sugar has risen from almost insignificance during the past 40 years to one of the leading money crops of Peru. It constitutes nearly a quarter of the total exports of the country, supplies local consumption, and furnishes about 60 per cent of the alcohol made in the country. It gives steady employment on a large scale to the uneducated laborers attached to each extensive *hacienda*, offers many responsible positions to the educated class, creates a demand for foreign agricultural implements, milling machinery, and railway equipment.

Physical factors favor cane culture. Friable, alluvial, sandy loam soils to which is added 150 to 200 pounds of Peruvian guano per acre annually, a proper application of water, the large number of sunny days, and continuously high temperature afford optimum conditions for a uniformly large yield of good quality cane. In general, the yield of cane in Peru ranges from forty to sixty metric tons per acre. In contrast Cuban yields of cane average only twenty. It should be remembered, however, that the crop in Cuba is annual, whereas in Peru cane requires from eighteen to twenty-two months to reach maturity.

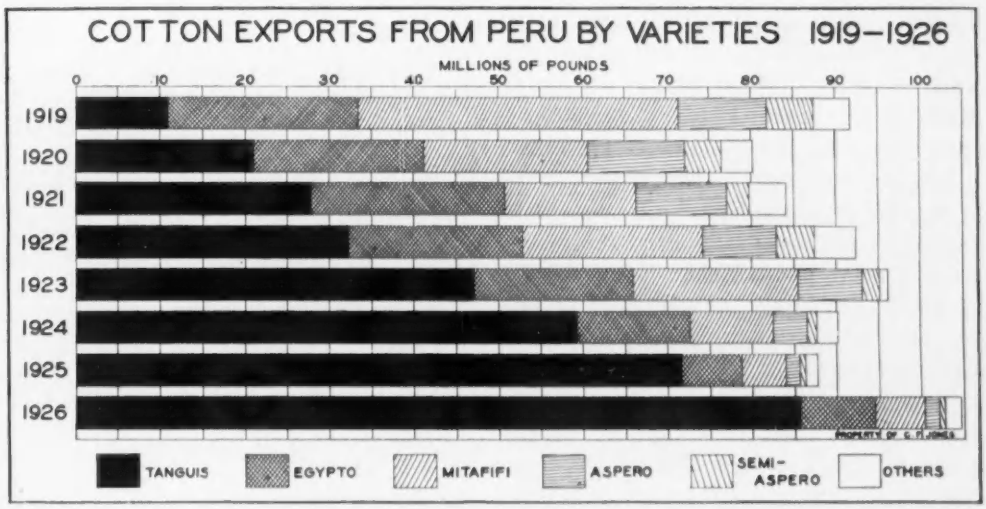


FIGURE 96.—Since 1919 the continued high export movement of cotton from Peru has resulted primarily from the phenomenal rise in the shipments of *Tanguis*, as all other varieties have registered a striking decline.

Production of sugar cane is confined chiefly to fifteen valleys, although a number of others produce minor amounts (Fig. 97). The Trujillo district in Libertad occupies the premier position in Peru. Here, the sugar industry overshadows all other activities; the Chicama, Moche, and Viru Valleys are entirely given over to it. This district alone produces about one-half of the total crop of

Peru. The plantation system of cultivation prevails; the producers have attained a high degree of scientific cultivation and mechanical proficiency comparable with methods in the leading sugar countries of the world.

The absence of rain, the abundance of sunshine, and the uniformly high temperatures make it possible to plant cane during practically every month of the year if water is available, although the larger areas are laid out during the flood season from November to April. Three cuttings are usually obtained from one planting, but seven or eight cuttings are common on the better lands. Therefore, only portions of the fields are planted from year to year. Moreover, cane may be cut and ground the year round, thus avoiding a rushed harvest season as in other regions and supplying a fairly steady flow of sugar for the export movement through out the year.

The large estates, some containing thirty thousand acres, have made possible the introduction of modern methods and expensive machinery and equipment, factors which play an important part in the commercial production of the crop, for they influence vitally the quality of the finished product and reduce materially the waste in the old grinding methods.

In addition, the cane districts of Peru are favored by cheap labor for the average cost of labor on the sugar estates amounts to only half the average wages paid in Hawaii or Cuba. Of all the major cane-growing countries, only Java has a lower wage than Peru.

It is impossible to maintain the rate of increase established between 1910 and 1920 in the production and

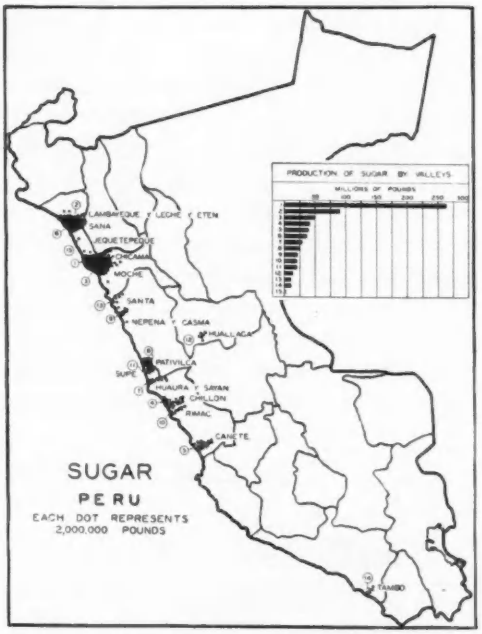


FIGURE 97.—Grown in most of the irrigated valleys, sugar production in three districts prominently stands out. These supply more than 90 per cent of the total.

exportation of sugar. In the valleys actually producing cane, practically all the land for which water exists for irrigation is already under cultivation. But, with the introduction of tractors and other machines which will release for sugar cultivation lands now in pastures and crops for the animals used on the estates; with a more efficient utilization of water; with the introduction of better machinery that will extract a larger percentage of sucrose; and with the opening-up of desert lands by the several new irrigation works now under construction, a considerable expansion in the industry may take place.

### SUBSISTENCE CROPS

Rice cultivation has developed steadily for the past decade. Many of the *haciendas* grow it, but the bulk of the crop is produced by Asiatics

and the small farmers of the Indian or mestizo class.

The ease with which rice can be threshed, cleaned, and prepared for food appeals to the native who has little or no scientific knowledge of agriculture. Easily prepared and combined with nitrogenous beans or other legumes, it makes a satisfying and nourishing meal. Rice, planted any time during the season of abundant water, from November to March, is produced with one flooding and little plowing. Two crops are usually harvested during the harvest season from May to August. The average yield of about 1,800 pounds per acre equals or excels the output per acre of the United States. Public mills are available for the small planter, while most of the large *haciendas* have their own.

Production of rice is confined largely to the coastal valleys of Lambayeque and Libertad (Fig. 98). These two departments supply about 48,000 metric tons or 75 per cent of the total. Considerable quantities are also raised in the coastal valleys to the south. To replace the exports and to supply the excess demands over production, rice must be imported from the Orient, United States, and Brazil.

In the irrigated valleys of the coast, corn, planted practically any time that water is available, matures in three or four months. Two or three crops may easily be grown in one year, which accounts for so much being raised in the coastal desert. Besides furnishing the natives with a considerable part of their food supply, large quantities of the crop are used for making "chicha" the most common beverage of the lower classes, It also supplies much forage for the *hacienda* animals.

FIGURE 98.—Most of the rice of Peru is grown in the irrigated valleys of Lambayeque, Sana, Chicama, and Moche.

A variety of legumes are grown in the coastal desert of Peru, but beans are the most important. Produced over a wide area and grown under a variety of names, they constitute an important part of the food of the people. The many different varieties of field beans, black, brown, and others, are generally known by their particular name in trade. Broad or horse beans, which thrive in all parts of the country, are the chief variety produced. Grown only for local needs, they are chiefly an intertilled crop, thus needing little cultivation. They can be harvested easily, possess good keeping qualities, and like rice require little effort in their preparation for eating. They can be planted almost any time in the irrigated lands, two or three crops may be gathered annually. Peas grow extensively in certain sections, as do lentils, lima beans, chick peas, peanuts, and many garden vegetables.

Tobacco, wheat, barley, and alfalfa find a place in the agricultural economy of many of the coastal valleys. The cultivation of tobacco in Peru, subject to the control of the Tobacco Monopoly (*Estanco del Tabaco*), is grown in zones established by the monopoly; all grown must be sold to this monopoly. For this reason and because of the great variations in quality and grades of Peruvian tobacco, owing to the more or less primitive methods employed in growing, there has been little or no attempt to encourage its growth. In fact many sections which formerly produced considerable quantities have practically abandoned the industry.

Wheat has been replaced by rice in the coastal desert; barley grows chiefly in the highlands, but in a few places is grown for forage crop. Alfalfa, much better for forage than barley, grows in many of the irrigated valleys and is widely used for animal feed. With a larger use of alfalfa in rotation and as range land for animals the *haciendas* could profit materially.

With the large amounts of sunshine and the continuously high temperatures, there are no better fruit lands anywhere than the irrigated valleys of the coastal desert of Peru. Bananas, oranges, lemons, and limes grow side by side with peaches and pears, delicious cherries, plums, dates, and figs. There are olives, grapes, watermelons and muskmelons, *guavas*, also papayas, chirimoyas, nisperos, and alligator pears.

FIGURE 99.—The tall, rough, strong animals of the Coastal Desert are excellent for the heavy draft purposes but are not well adapted to the production of a good quality meat. (Courtesy of W. A. Orton.)

The vine and the olive have received greatest attention, yet are only of local importance. The chief grape sections include the Ica, Pisco, Chincha, and Moquigua Valleys. Oranges of excellent grade grow in many places. Limes and lemons, while widely distributed, are usually of inferior quality; the bananas are small and in many cases insipid.

Fruit can be found for sale at very reasonable prices in almost every town and railway station along the coast.

### ANIMALS

Devoid of natural range land and lacking large areas of pastures in the valleys the irrigated valleys support a minor part of the animals of the country.

Cattle lead in numbers. Tall, rough, and bony, they furnish the chief power for heavy work on many *haciendas* and provide a meat supply for all the region and some surplus for shipment to the nitrate fields of Chile. In the neighborhood of cities restricted dairy enterprises have sprung up. Most of the cattle of native breeds dress into a low-grade meat; little effort has been made to improve the stock, the old breeds being quite well adapted for their chief use (Fig. 99). High temperatures, flies, abundant ticks, poor forage, and ignorance of the laboring classes hinder the animal industry. While the large *haciendas* are supplied with some alfalfa and other artificial range land for animals, withering crops in times of frequent water shortage get the first application of the precious liquid.

Asses, mules, horses, swine, and goats find a small place in the economy of the *haciendas* of most valleys, though they do not total large numbers. Asses, mules, and horses are raised for transportation purposes on the estates and to the coastal ports. A few valleys rear them for exports to highland mining districts. Swine, a general scavenger, yield a local supply of meat. Goats, capable of picking a precarious living from the desert edges where other animals would perish, are reared everywhere, but especially in the fog- and mist-covered area of the Coastal Range and in the *Algarroba* regions of the north, where the fleshy pods of the tree provide abundant feed. They supply chiefly skins and meat, although in some districts the milk is used.

### TRENDS

With a regulated water supply and a constant supply of rich guano, the yields of the irrigated coastal valleys may be increased materially. Small dams even on small streams to impound the flood waters of the rainy season and the huge irrigation works now under construction will bring marginal strips into productivity and turn drifting sands and algarroba lands into verdant fields. Nevertheless, the irrigated area can be increased not more than 40 per cent. On the other hand, modern machinery, improved irrigation systems, better methods of cultivation, effective means to combat insect pest and diseases, the general improvement of the living conditions of the agrarian class, and a more intensive utlization of the animal possibilities, will augment considerably the output of this agricultural region and establish a better balance between commercial and subsistence products.

# IRON AND STEEL INDUSTRY OF THE CLEVELAND DISTRICT

*John B. Appleton*
Geographer, University of Illinois

THE iron and steel industry is one of the leading manufacturing activities in the United Kingdom. Before the war it provided direct employment for almost 300,000 men. At the same time all the metal industries, including engineering and shipbuilding for which iron and steel are the basic raw materials, gave employment to 1,750,000 men, or approximately 12 per cent of the total wage earners of the country. The chief producing area is the Cleveland District.

The relative importance of the British iron and steel industry is shown in Figure 1. This gives the comparative production of the four leading countries that normally account for approximately 80 per cent of the world output. From this graph it may be seen that in 1913, and in 1924, the United States produced twice as much iron and steel as Germany which ranked second, and more than three times as much as the United Kingdom which occupied third place. It is significant that France, as a result of post-war territorial additions, including the important iron and steel industries of Alsace and Lorraine, increased her production notably. Britain, however, is still the chief exporter of iron and steel.

The production of pig iron and of steel in the United Kingdom from 1911–1925 is shown in Figure 2. Up to 1913 there had been a steady increase in the output of steel owing to the increased use of that material. The 1911 figure for pig iron represents more or less normal production over a long period. From 1914–1919 war demands led to a great increase in the consumption of steel, hence the very rapid increase in production. Labor disturbances and the post-war depression in industry were responsible for the very marked slump in 1921. The rapid recovery in 1922 was not maintained owing to the continued trade depression and intense foreign competition.

The bulk of the iron and steel produced in Britain is utilized at home by the great engineering and fabricating industries. Of these the most important are shipbuilding, machinery, structural steel, railroad material, and tin plate. The Cleveland District specializes in these types of products and supplies both home and foreign markets.

Normally almost half the iron and steel produced is exported in a wide variety of fabricated forms and they constitute one of the chief groups of British exports. They are marketed all over the world but the British Dominions take about half. India, Australia, Argentine, South Africa, New Zealand, and the United States are the chief customers. This export trade has been made possible by the favorable conditions under which the industry has been carried on in respect to raw materials, coking coal, shipping facilities, and Britain's world wide trade associations.

Figure 2 indicates the marked decrease in exports during the war period, when the home demand was intensified. A similar decrease in the imports is also explained by war conditions. It should be noted that slightly more than half the imported iron and steel normally consists of pig iron and steel blooms and billets which are used to supplement home production. Belgium, France, and Luxemburg supply most of this additional material. The remaining imports comprise all kinds of manufactured iron and steel products.

Figures 4 and 5 show the relative importance of the chief iron and steel districts. The outstanding importance of the Northeast Coastal area, of which the Cleveland District is the most significant part, for pig iron is clearly shown in Figure 4. In 1924, it was the leading producer of pig iron and ranked second to South Wales in the making of steel. In 1913, its position was still more dominant.

Approximately 30 per cent of the pig iron and 20 per cent of the steel output of the country is produced in

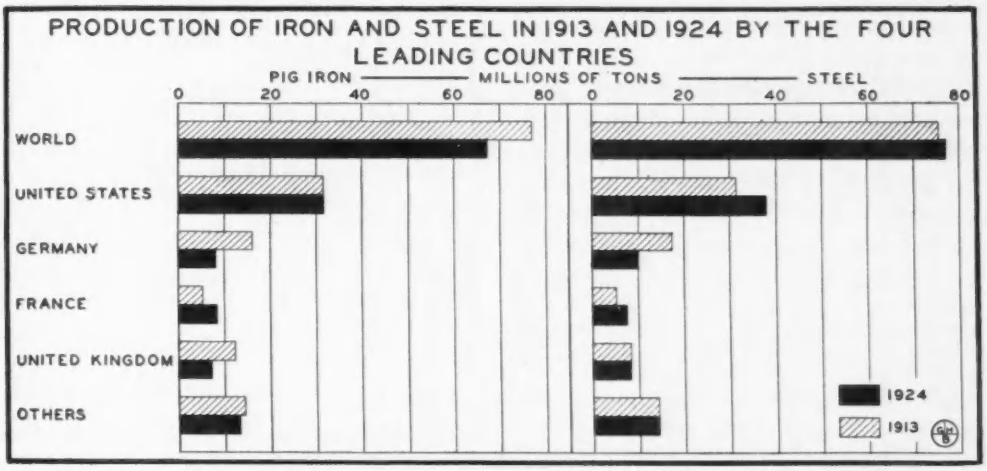


FIGURE 1.—A self-explanatory comparison of the pig iron and steel production of the chief producing countries. (Compiled from statistics published by The National Federation of Iron and Steel Manufacturers, London.)

## CLEVELAND INDUSTRIAL DISTRICT

The production of iron and steel like all the major manufacturing industries of Great Britain is concentrated on the coal fields and particularly on those adjacent to the coasts where good harbors provide easy access to the sea. Generally speaking, blast furnaces rather than steel mills predominate in the coastal areas where the local supply of iron ore, so generally associated with British coal fields, can be supplemented easily by imported ores (Figure 3).

the Northeast Coastal area. The industry is largely concentrated in the Cleveland District, along the lower reaches of the River Tees, where 80 per cent of the blast furnaces and the most up-to-date steel mills are located. Middlesbrough is the center of this thriving urban industrial area (Figure 3). West Hartlepool and Seaton Carew are near enough to the mouth of the River Tees to be included within this area. The Cleveland District is primarily interested in the smelting

of iron and the manufacture of basic open-hearth steel. Much of this is shipped out of the district in manufactured and semi-manufactured form to the great shipbuilding and engineering plants along the Tyne and the Clyde, and to Sheffield, Birmingham, and other inland manufacturing centers.

The outstanding advantages offered by the Cleveland District, where, as has been noted, practically all the most up-to-date plants in the country have been built, are: (1) nearness to abundant supplies of Durham coking coal, to the Cleveland ironstone, and to limestone deposits in Durham suitable for flux; (2) tide-water sites along a navigable waterway accessible to large vessels; (3) imported ores, upon which the industry now largely depends, can be unloaded directly on the wharves of many of the plants in which they are to be used; (4) lower freight rates on

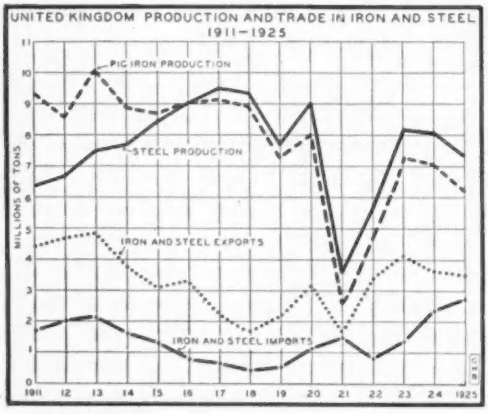


FIGURE 2.—A comparison of the production of pig iron and steel and of the exports and imports of iron and steel by the United Kingdom. (Compiled from statistics published by The National Federation of Iron and Steel Manufacturers, London.)

imported iron ores which are possible because this is an important coal exporting district and colliers returning from the Mediterranean and Baltic regions can bring back iron ores instead of returning in ballast; (5) coastwise shipping provides cheap

FIGURE 3.—The British coal fields. The Northeastern Coastal Industrial Area coincides in part with the Northumberland and Durham field. The Cleveland District lies near the southern boundary of this area in northeastern Yorkshire. (Courtesy of the *Manchester Guardian*.)

transportation for the movement of iron and steel to other coastal fabricating centers; (6) adequate shipping facilities for the export of iron and steel products to all parts of the world; (7) excellent railroad communications with all parts of Britain; and (8) abundant space well suited to this type of industry.

Jarrow, on the River Tyne near Newcastle, and Consett are the chief centers outside this district, but, compared with the Cleveland District, their production is small.

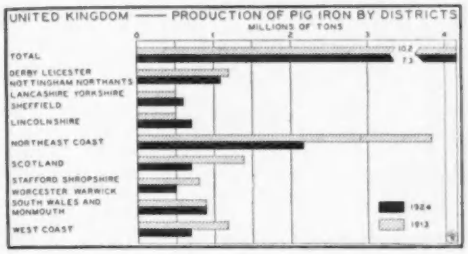


FIGURE 4.—A comparison of pig iron production by districts in the United Kingdom. (Compiled from statistics published by The National Federation of Iron and Steel Manufacturers, London.)

## LOCATION WITH REFERENCE TO RAW MATERIALS

The area is fortunately situated with respect to the raw materials upon which this industry is based.

### *Iron Ore*

The chief source of iron in the United Kingdom is found in the oolitic escarpment which stretches across England from the Severn to the Tees. This formation contains 50 per cent of the reserves of the country. This low upland belt terminates in the Cleveland Hills in an abrupt north-facing scarp along which the ironstone outcrops. Figure 6 shows the principal outcrops, the chief mining centers, and the character of the upland which is capped with a resistant calcareous sandstone of the oolite series. The ironstone is relatively near the surface in the valleys so that mining is comparatively easy. In many places drift mining is possible and the main seam varies from 5 to 12 feet in thickness. Cutting machinery is in general use. Figure 7 shows a cross section of the area from northwest to southeast, and shows the relations between the ironstone and the surrounding rocks.

The proximity of this ironstone to the mouth of the River Tees which necessitated only a very short haul mainly down grade, encouraged the beginning of iron smelting there in the middle of the nineteenth century. Abundant supplies of high-grade coal and of limestone from near-by sources in Durham were also available. The low cost of assembling these commodities at the mouth of the Tees offset the low grade of the ironstone. In addition the ironstone could be shipped coastwise to other conveniently located centers, chief of which was Newcastle, where abundant supplies of coal were also available for industrial purposes.

At the present time the more accessible and higher-grade ironstone in the Cleveland District has been exhausted. The average distance from the mines to the riverside furnace is less than twenty miles. Formerly it was much less. With increasing distance from the Tees the seams become thinner, leaner, and more expensive to work. The iron content of the stone now being mined is

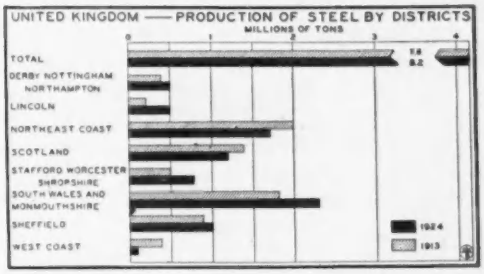


FIGURE 5.—A comparison of steel production by districts in the United Kingdom. (Compiled from statistics published by The National Federation of Iron and Steel Manufacturers, London.)

slightly below 30 per cent. In 1924, the production amounted to 2,200,000 tons, only one-third that of 1913 when 6,000,000 tons were mined (Figure 8). The mining industry there provides employment for some 4,000 men. The present production is insufficient for the needs of the Cleveland District and economic con-

ditions make the use of higher-grade ores imperative. In 1924, almost 2,000,000 tons of foreign ores were imported by Tees-side smelters, practically one-third of the total British importation. The furnaces at West Hartlepool and Seaton Carew use foreign ores almost exclusively.

The trend in the consumption, production, and importation of ore is indicated by the graphs in Figure 8. It is significant to note that while production has steadily declined since 1913, the tonnage imported has remained more or less constant, indicating the increasing significance of imported ores in the British iron and steel industry.

The sources of these imported ores are shown in Figure 9. Spain, Algeria, Sweden, and Norway supply the largest quantities. Present indications point to a great increase in the consumption of Algerian and Tunisian ores in the Cleveland District. These are of almost equal quality to the Rubio ores of Spain, but offer a slight advantage in price and freight. These high-grade hematite ores now form the basis of the British steel industry since half the blast furnaces use these exclusively. Their extensive use is practicable largely on account of (1) cheap water transportation, (2) the tide-water location of many of the furnace groups, particularly in the Cleveland District, (3) the higher iron content, and (4) the relatively low price of the ores.

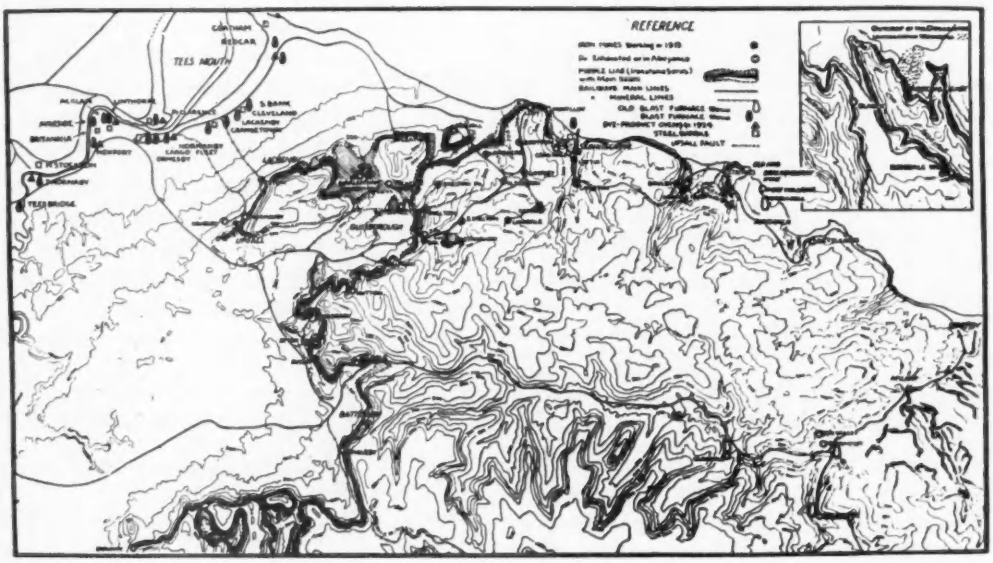


FIGURE 6.—Northeastern Yorkshire, showing the main outcrop of ironstone and the blast furnace groups adjacent to the Tees Estuary in the Cleveland District. (Courtesy of Ll. R. Jones.)

### *Coal*

The Cleveland industrial district is adjacent to the southwestern part of the Northumberland-Durham coal field. The rail haul from the mines averages only 25 miles and consequently, the cost of assembling is low. The coal yields a high-grade, hard coke of fine, even texture, which does not clog the furnace, is low in sulphur and silicon, and is eminently suitable for metallurgical purposes. The seams average from three to five

feet in thickness. Figure 10 is a cross section from west to east across Durham. It shows the gentle dip from west to east of the seams and their relation to the surrounding rocks. The largest as well as the deepest mines throughout this field are located near the coast within easy reach of good harbors, where coastwise shipping is available to move the coal to the great industrial centers of northeastern England, which utilize much of the iron and steel that is produced in the Cleveland District, and to foreign countries.

Much of the coal of southwestern Durham is still coked in beehive furnaces at the mines, but, in recent years, particularly during and since the war, modern by-product ovens have been installed at many of the mines and in juxtaposition with some of the blast furnace groups. This has resulted in the production of large quantities of valuable by-products such as gas, tar, ammonium sulphate, ammonia liquor, benzol, and napthalene, all of which have considerable market values. Where the coking is carried on beside the iron and steel plants the use of some of these products, particularly tar and coal gas, which formerly were wasted, has reduced the consumption of both coal and coke and thereby has lowered the costs of producing iron and steel. The grouping of by-product coke ovens, blast furnaces, steel smelters, and rolling mills in the Cleveland District has facilitated the full utilization of by-product fuels, including blast furnace gases (Figure 6). These are employed to heat the blast, to convert iron into steel, to maintain heat in the soaking pits, to operate rolling and plate mills, and to produce power. Where the by-product ovens have been installed at the mines, the power derived from the by-products is used to operate the mines. This reformation in the industry has been necessitated by increasing costs of production and by foreign competition.

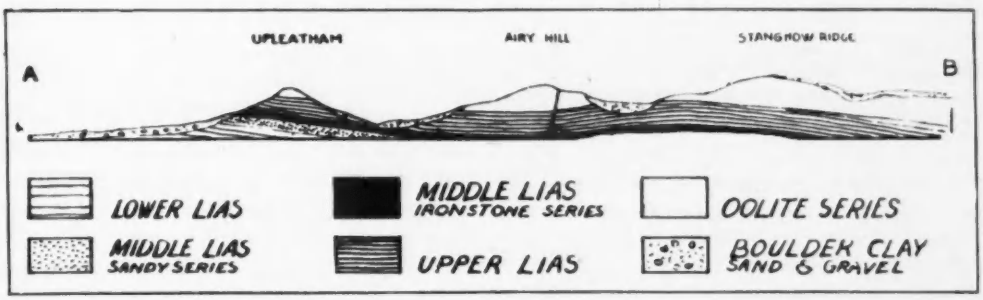


FIGURE 7.—A cross section from NW–SE across the Cleveland District to show the relation between the ironstone seams and surface features. (Courtesy of Ll. R. Jones.)

### *Limestone*

Adequate supplies of limestone suitable for fluxing purposes are available within easy reach of the district. Large exposures of Carboniferous limestone occur in the valley of the River Wear. In addition there are exposures of magnesian limestone in which occur beds of almost pure limestone. The latter are worked extensively near Sunderland and Darlington. The magnesian limestone is used primarily for lining basic converters.

Owing to the high phosphorous content of the Cleveland ironstone, the furnaces yield a highly phosphatic slag. When ground fine, this is an excellent fertilizer and is extensively used for that purpose in England.

In addition to the production of fertilizer on a large scale, slag is used extensively for the manufacture of bricks. Large plants have been established in connection with some of the steel plants, and there is a ready market for their product.

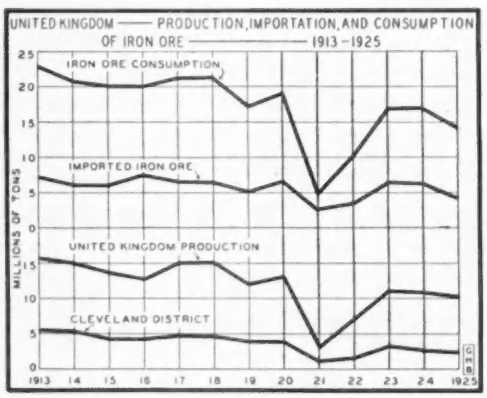


FIGURE 8.—A comparison of the production, importation, and consumption of iron ore from 1913–1915. (Compiled from statistics published by The National Federation of Iron and Steel Manufacturers, London.)

A number of the larger firms own and operate their collieries, limestone quarries, and ironstone mines. Bolchow, Vaughan and Company, of Middlesbrough, produce some 2,000,000 tons of coal and 30 per cent of the output of the whole Cleveland ironstone field from their own mines. These operations are carried on scientifically with a view of reducing the cost of producing the iron and steel. This company has a productive capacity of 800,000 tons of pig iron and 500,000 tons of steel ingots per annum, and a very large output of valuable by-products, including fertilizer and slag bricks.

## LOCAL CONDITIONS ARE FAVORABLE FOR IRON AND STEEL PRODUCTION

The local conditions of site and situation are peculiarly advantageous for the development and maintenance of a first-class industry.

### *Suitable Sites Adjacent to a Navigable Waterway*

Owing to the bulky and heavy nature of the commodities that are handled, all the processes of iron and steel manufacture are confined to single story buildings so that a large area is required for a complete installation. The abundance of vacant, flat, and often marshy land fronting the river, much of which has been reclaimed, affords excellent sites for iron and steel plants and has encouraged their concentration there. Figure 11 shows the river-side location of one of the larger plants.

In order to make the Tees estuary accessible to large vessels and thereby foster industrial growth, extensive harbor improvements have been made. The entrance was blocked originally by a sand bar which was covered by three and a half feet of water at low tide. The river followed three winding channels through extensive mud flats which were exposed at low tide. Navigation, therefore, was hazardous and restricted to very small boats. The Tees Conservancy Commissioners have dredged a deep waterway and by restricting the channel between retaining walls have increased the tidal scour. The depth of water at the entrance to the river is now 37 feet at high water, so that the largest classes of boats can enter. As numerous deep-water berths, with as much as 25 feet of water at low

tide, are available, unloading and loading can be carried on without difficulty or delay. Consequently, iron and steel plants, which in most cases are adjacent to the river, can have their own wharves for the reception of imported ores and for the shipment of iron and steel products. The wharves are equipped with up-to-date machinery for the rapid handling of these commodities. In addition, a large dock, 26 acres in extent and containing almost 7,000 feet of quays, has been provided by the port authority at Middlesbrough. The entrance is 80 feet wide and has 32 feet of water over the sill at high water. This dock is especially designed to handle the shipments of iron and steel products from Tees-side plants. Regular steamship services are maintained between Middlesbrough and all parts of the world so that the marketing of these products can be carried out with minimum delay.

In conjunction with this work large areas of tidal foreshore along both sides of the river have been reclaimed and a considerable acreage is in process of reclamation. Along the southern shore all this land not already occupied by iron and steel plants, including that which is only partially reclaimed, has been acquired for industrial purposes, mainly by iron and steel interests. Such land is highly suitable for blast furnace plants since the waste products can be used to complete the fill. Additional dock facilities which will stimulate industrial expansion in the area have been planned.

### *Labor Conditions*

As a result of the long-established industrial and commercial activities near the mouth of the River Tees, a great urban development has taken place. Prior to the discovery of the Cleveland ironstone, this was a sparsely populated agricultural district with Middlesbrough having only about 5,000 inhabitants. At the present time Tees-side has about 400,000 inhabitants of whom some 140,000 live in Middlesbrough and

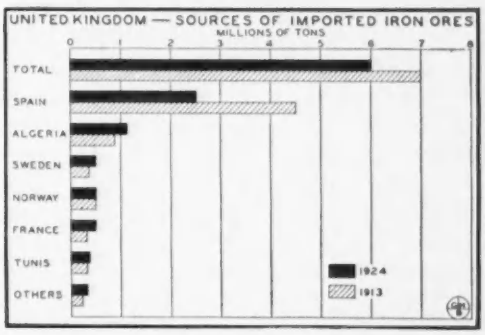


FIGURE 9.—A graphical presentation of the importation of iron ore into the United Kingdom. (Compiled from statistics published by The National Federation of Iron and Steel Manufacturers, London.)

84,000 in the twin towns of Stockton and Thornaby. A very large proportion of this population is engaged in the local iron and steel trades. The importance of the district has made it a mecca for iron and steel workers. Excellent railroad communications link it with all parts of Britain and particularly with the densely populated, industrially developed, northern counties. The London and North Eastern Railroad, an amalgamation of several former trunk systems, handles the bulk of the traffic in the Cleveland District. Its main lines serve the whole of eastern Britain in which is found every type of commercial and industrial activity, and intercommunication with the other railroad groups is readily effected. Consequently, an abundant supply of labor is available at all times and the movement of

commodities can be carried out expeditiously.

A belt of large towns has grown up along the south side of the estuary around the industrial plants from Tees-Bridge to Redcar. The most important are Middlesbrough, Stockton, Thornaby, South Bank, and Redcar. Most of this urban development has taken place along the south side of the river in response to the industrial development there, mainly iron and steel plants. Intercommunication between the various urban centers is made easy by an extensive railroad and street car net. As in most industrial areas the population has expanded into the surrounding countryside where living conditions are much more pleasant than in the neighborhood of the mills. Consequently, there is a large suburban population. North of the river the urban development has been greatest at West Hartlepool and Seaton Carew near the mouth of the estuary.

### PRODUCTS AND MARKETING ASPECTS

The Cleveland District normally produces a large surplus of pig iron and steel over and above the requirements of the local steel mills. Hence, there is considerable movement of these products to other parts of England, to Scotland, and to foreign countries. The location of the plants at the mouth of the River Tees, adjacent to deep water, readily permits the movement of a large tonnage of these bulky products by water. The railroads handle the bulk of the movement to inland centers, chiefly Sheffield and the Midlands. The smelters of the Clyde District of Scotland are the largest consumers of Cleveland pig iron. In 1924, 125,000 tons were shipped to that district, more than twice as much as to Belgium, the second largest consumer.

In 1924, from a total production of 2,000,000 tons the Cleveland District shipped approximately one-fifth or 443,000 tons of pig iron. Of this amount 273,000 tons were exported and 170,000 tons were sent coastwise to other centers in the United Kingdom. In 1913, the total shipments were much greater, being 1,247,000 tons, or approximately one-third of the output: 737,000 tons went abroad and 500,000 tons were distributed by coastal steamers. The marked decrease in shipments was caused, in part, by the general stagnation of trade but, in particular, by foreign competition. Another cause was increased local consumption.

Much of the hematite pig iron that is produced from imported ores is sent by rail to the Sheffield District for manufacture into special high-grade steels which are used chiefly for tools, alloy products, cutlery, guns, and naval equipment, for which that district is world famous. A smaller tonnage is sent to the steel centers of South Wales. Normally there is a smaller but similar movement of steel blooms and billets to the same centers to supplement local production.

In recent years, however, there has been a greater utilization than formerly of both pig iron and steel within the Cleveland District itself in the manufacture of more finished products. Approximately four-fifths of the total pig iron production in 1924 was converted into steel and used in the associated rolling mills for making finished steel products, chief of which were, plates and other shipbuilding materials, structural steel of all kinds, steel rails and other railroad equipment, sheets, and tubes.

The shipbuilding industry is without doubt the most important single user of Cleveland products. This is carried on to some extent along the Tees adjacent to the steel mills. Stockton has three large shipyards and West Hartlepool four, which normally produce a considerable tonnage of shipping. In 1913, the Stockton yards launched 24 ships with a total of 110,000 gross tonnage. In the same year West Hartlepool built 33 vessels with a gross tonnage of 153,000. Marine engineering and boiler making are also important industries which have been developed to supply not only the local shipyards but also those of Sunderland and the Newcastle district.

The great engineering industries of Northeastern England constitute a very large near-by market for a wide range of manufactured and semimanufactured iron and steel. Shipbuilding is normally of outstanding importance. About half the total tonnage of shipping launched in the United Kingdom is built in this area. The chief manufacturing centers are located along the lower Tyne, from Newcastle to the sea, forming one continuous industrial area, and at Sunderland at the mouth of the River Wear. As a result of their coastal location on good harbors, many of their needs can be supplied conveniently by coastwise steamers from Tees-side plants. The London and North Eastern Railroad which serves the whole area, also, handles a considerable tonnage.

Numerous inland centers, such as Darlington, largely interested in engineering, can receive their requirements readily by rail as the haul is relatively short.

Intensive mining operations also create a demand for iron and steel products, particularly, for machinery, pipes, and tubes.

Only slightly more distant are the other great manufacturing areas of Northern England. The Sheffield and Midland districts are primarily interested in iron and steel products. The manufacture of machinery is associated with the great textile industries of Yorkshire and Lancashire. Throughout the whole region there is a large demand for all kinds of structural steel, mining equipment, and railroad material. Barrow and other shipbuilding centers on the west coast use a considerable amount of Cleveland products. This extensive and varied market can be reached readily from the Cleveland District. The post-war increase in railroad rates, however, is a serious handicap to the Cleveland smelters who are finding it increasingly difficult to compete with foreign materials which are being put on the British market at prices far below the cost of the home product. The railroads constitute a large home market, as railroad materials, especially rails, are produced in considerable

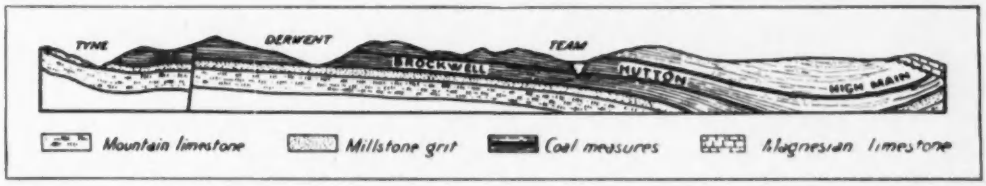


FIGURE 10.—A simplified section from west to east across the Durham coal field to show the dip of the seams towards the east. (Courtesy of Ll. R. Jones.)

quantities around Middlesbrough. A specialty of the district is the manufacture of high conductivity steel rails for use on electrically operated systems.

The export trade has been an important factor in the expansion of the Cleveland industry. This has been stimulated by adequate port facilities and regularly scheduled sailings to all parts of the world. The location of the plants has permitted direct loading and eliminated railroad handling to a very considerable extent. In addition to the export of pig iron which goes mainly to Belgium, Germany, Holland, the United States, and France, there is normally a large movement of iron and steel products to the British Dominions, South America, India and Ceylon, and the Far East. Rails, structural steel, and tubes are the chief items in this trade. In recent years the Cleveland District has been giving increasing attention to the production of high-grade finished products of this type and thereby utilizing locally a larger proportion of the pig iron production.

The following table indicates the principal markets for Cleveland iron and steel products in 1924:

| | *Tons* |
|---|---|
| India and Ceylon | 162,491 |
| South Africa | 55,080 |
| China and Hongkong | 19,363 |
| Japan | 25,085 |
| Egypt | 17,032 |
| South America | 47,529 |
| Australia and New Zealand | 76,751 |
| Straits Settlements | 12,612 |
| Germany | 4,006 |
| Others | 227,331 |
| Total | 647,000 |
| Total United Kingdom Export | 3,851,435* |

* Compiled from Consular Reports and *Statistics of the Iron and Steel Industries* (1925), N. F. I. & S. M., London.

In that year the Cleveland District produced approximately 1,720,000 tons of steel, 20.9 per cent of the national output, and furnished 17 per cent of the exports. Compared with 1913, exports had decreased by 27 per cent in 1924 owing to capture of many overseas markets by foreign competitors.

## TRENDS IN THE INDUSTRY

Probably one of the most significant changes in the industry is the rapidly decreasing significance of the Cleveland ironstone. The industry is becoming dependent more and more upon imported supplies and it can be only a matter of a short time before local ores will form only a supplementary source of supply. As a result the location of the district in respect to receiving supplies of ore from abroad is now of greater significance than its proximity to local ore and the Durham coal field which gave the district its early supremacy in iron manufacture. The Cleveland District is no longer the chief producer of iron ore in England as it was ten years ago. Northamptonshire is now producing twice as much. Owing to its accessibility and the ease with which it can be extracted the cost of producing ore there is only 64 cents per ton compared with $1.60 in the Cleveland District. Yet, only about 250,000 tons of Northampton ore are used annually by Cleveland furnaces, and that only since 1920. High rail rates have made it possible for Cleveland ironstone to compete successfully with that of Northamptonshire.

Since 1924 there has been a marked decrease in the production of iron and steel not only in the Cleveland District but in Britain as a whole. This has been caused by the loss of much of the overseas trade as a result of intense foreign competition, particularly French, and also to the flooding of the English home market

with pig iron at prices far below the cost of the British product. This higher cost of manufacturing iron and steel is due mainly (1) to the much higher wages paid in England compared with those in France, Germany, and Belgium, (2) to the high railroad rates which have been increased 50 per cent for long distances and almost 100 per cent for short hauls compared with those of 1913, and (3) to the very heavy imperial and local taxation. To meet the increased foreign competition plants have been modernized, and those of the Cleveland District represent "the last word" in equipment and organization. At the present time the pig iron production of the district is practically in the hands of three great steel combines which are employing every possible means at their disposal to lower costs of production and thereby regain some of their lost markets.

[NOTE.—This article is the second on this district, a more intensive study than the general article presented by John W. Frey in the previous issue of ECONOMIC GEOGRAPHY.]

# BOOK REVIEWS

DEPARTMENT OF COMMERCE

Bureau of Foreign and Domestic Commerce

*British Colonial Office Reports on the Rubber Situation.* By E. G. Holt. Trade Information Bulletin No. 603. Price, 10 cents.

Restriction of rubber exports from Malaya and Ceylon, initiated in 1922 and abandoned in 1928, is a subject of much general interest. The present bulletin is a collection of the published official British documents relating to rubber restriction, with the addition of a few statistical tables showing the effect of restriction on planting and production of rubber, and on the use of reclaimed rubber.

*The Brazilian Foodstuffs Market.* By M. A. Cremer. Trade Information Bulletin No. 604. Price, 10 cents.

This bulletin is a brief survey of the Brazilian import and export markets for foodstuffs. While it is an agricultural country, Brazil's products are largely of a semitropical nature, such as coffee (the principal agricultural product), citrus fruits, corn, and cotton. The country is, therefore, dependent on outside sources for many other products. The great market centers are Rio de Janeiro and São Paulo, one-half of the country's population being within a radius of 500 miles from these two cities.

*German Chemical Developments in 1928.* By William T. Daugherty. Trade Information Bulletin No. 605. Price, 10 cents.

A knowledge of what Germany is doing with chemicals is almost as vital to American manufacturers as information on domestic developments, not because of the size of the German industry, but because of its initiative in developing new processes and in forming international agreements through cartels. Germany is the second largest producer of chemicals in the world and has regained its pre-war position as the largest exporter, but the value of all the chemicals it produces is probably no greater than the combined chemical production of New York, New Jersey, and Pennsylvania.

*Economic Development of Siam.* By M. A. Pugh. Trade Information Bulletin No. 606. Price, 10 cents.

This bulletin discusses the principal features of recent economic and commerical developments in Siam. In its preparation frequent reference was made to annual reports of the various Siamese Government Departments, to the records of the official board of commercial development, and to a series of pamphlets on Siam printed by the *Bangkok Times Press*, in November, 1926.

*Glossary of Paper Terms and Instructions to Exporters. Reprint, April, 1929, with Corrections.* For guidance in properly listing and classifying exports of paper and paper products on Shippers' Export Declarations.

*The Retail Grocer's Problems.* By W. F. Williams. Distribution Cost Studies No. 5. Price, 10 cents.

*British Market for American Dairy Equipment and Supplies.* By Brice M. Mace, Jr. Trade Information Bulletin No. 598. Price, 10 cents.

*Boot and Shoe Industry and Trade in Great Britain.* By Harold A. Burch. Trade Information Bulletin No. 607. Price, 10 cents.

*Motion Pictures in Australia and New Zealand.* Compiled by E. I. Way. Trade Information Bulletin No. 608. Price, 10 cents.

*Radio Markets of the World, 1928–1929.* By Lawrence D. Batson. Trade Information Bulletin No. 600. Price, 10 cents.

The importance of foreign markets for radio equipment is attested by the value of United States exports. This bulletin presents information as to the basic character of the various markets and will serve as a reliable guide for the exporter of radio goods. It covers all countries of the world and gives for each full information on the particular conditions that affect the use of radio apparatus, such as climate, topography, Government regulations, fees, broadcasting stations, etc.

*Markets for American Foodstuffs in Siam.* By Don C. Bliss. Trade Information Bulletin No. 610. Price, 10 cents.

American products are popular with the Siamese, who have developed a very friendly attitude toward the United States, and American goods are being purchased to an increasing extent each year. Foodstuffs rank as the largest single class of goods imported, although textile imports are of about equal importance.

*The Market for Household Electric Appliances in Germany.* By C. T. Zawadzki. Trade Information Bulletin No. 609. Price, 10 cents.

*The Automotive Market of Australia.* By Charles F. Baldwin. Trade Information Bulletin No. 611. Price, 10 cents.

*The Production of Iron and Steel in Japan.* By J. H. Ehlers. Trade Information Bulletin No. 612. Price, 10 cents.

Because of the development of the Japanese industry in recent years and because Japan has

been and is even now one of the principal markets of the world for steel products, the expansion of the industry of that country is of especial interest to the industries of the United States. Japan is worthy of consideration as a producer of steel and steel products quite apart from its importance as a consuming market. In 1928 and for several years past Japan has ranked tenth among the countries of the world in volume of steel produced.

*American Underwriting of Foreign Securities in 1928.* Trade Information Bulletin No. 613. Price, 10 cents.

*Motion Pictures in India.*. Compiled by E. I. Way. Trade Information Bulletin No. 614. Price, 10 cents.

Japan is today one of the largest export markets of the world for iron and steel products, a distinction which it has enjoyed for many years and which, despite increasing domestic production, it seems likely to enjoy for some years to come. The greater part of the statistical material presented in this report was obtained through the courtesy of the Department of Finance and of the Mining Bureau of the Department of Commerce and Industry of the Japanese Government.

*Canadian Loan Corporations.* By Emil Sauer. Trade Information Bulletin No. 616. Price, 10 cents.

*The European Motion-Picture Industry in 1928.* By George R. Canty. Trade Information Bulletin No. 617. Price, 10 cents.

*Markets for Dairy Equipment and Supplies in Continental Europe.* Trade Information Bulletin No. 618. Price, 10 cents.

American dairy equipment, while highly regarded in those markets where it is known, has comparatively little sale in Europe, principally because purchases are being made largely on a price rather than a quality basis. If, therefore, American dairy machinery is to secure a satisfactory share of this business, considerable educational work will be required on behalf of the quality product. The market surveys which follow will serve to indicate those countries in which sales effort may be expended to the best advantage.

*European Markets for American Motion-Picture Equipment.* Compiled by N. D. Golden. Trade Information Bulletin No. 619. Price, 10 cents.

*British Chemical Trade in 1928.* By Homer S. Fox. Trade Information Bulletin No. 621. Price, 10 cents.

*Transcontinental and Intercoastal Trade of the Pacific Southwest in 1926.* By Robert J. McFall. Domestic Commerce Series No. 25. Price, 25 cents.

*Trading Under the Laws of Argentina.* By Joaquin Servera. Trade Promotion Series No. 74. Price, 25 cents.

*International Fairs and Expositions.* Trade Promotion Series No. 75. Price, 20 cents.

*International Trade in Citrus Fruits.* By Daniel J. Moriarty. Trade Promotion Series No. 77. Price, 10 cents.

*The American Chemical Industry.* By A. H. Swift. Trade Promotion Series No. 78. Price, 20 cents.

*International Trade in Petroleum and Its Products.* By H. G. Denham. Trade Promotion Series No. 80. Price, 25 cents.

*Shipment of Samples and Advertising Matter Abroad—Including the Use of Parcel Post in Foreign Trade.* By Roberta P. Wakefield and Henry Chalmers. Trade Promotion Series No. 72. Price, 40 cents.

*Sales Territories in Middle Asia and the Philippine Islands.* By Donald Renshaw. *Departamento de Comercio de los Estados Unidos. Breve descripcion sobre las actividades de las varias oficinas del Departamento.*

*Monthly Summary of Foreign Commerce of the United States,* Part II, December, 1928; Part I, January, 1929; Part II, January, 1929; Part I, February, 1929; Part II, February, 1929; Part I, March, 1929. Subscription, $1.25 per year. Single copy, Part I, 10 cents; Part II, 5 cents.

*Supplement to Annual List of Publications.* Compiled monthly by the Division of Publications of the Department of Commerce. This may be obtained without charge upon request to the Chief of Division of Publications. It enables the user to keep in touch with the current publications of the Department of Commerce.

### AERONAUTICS BRANCH

*Airport Rating Regulations.* Aeronautics Bulletin No. 16.

### U. S. COAST AND GEODETIC SURVEY

*Current Tables. Pacific Coast, North America and Philippine Islands, 1930.* Price, 10 cents.

*Current Tables. Atlantic Coast, North America, 1930.* Price, 10 cents.

*Catalogue. Charts, Maps, Coast Pilots, Tide Tables, Current Tables (Philippine Islands Charts Catalogued Separately), April 1, 1929.* Serial No. 437. This catalogue may be obtained free of charge.

*Sup. to United States Coast Pilot, Atlantic Coast, Section B, Cape Cod to Sandy Hook.* Serial No. 440.

*Sup. to United States Coast Pilot, Alaska, Part II, Yakutat Bay to Arctic Ocean.* Serial No. 441.

*Sup. to United States Coast Pilot, Philippine Islands, Part I, Luzon, Mindoro, and Visayas.* Serial No. 442.

*Sup. to United States Coast Pilot, Philippine Islands, Part II, Palawan, Mindanao, and Sulu Archipelago.* Serial No. 443.

*Sup. to United States Coast Pilot, Alaska, Part I, Dixon Entrance to Yakutat Bay.* Serial No. 445.

*Coast and Geodetic Survey Bulletin.* Compiled monthly by the Division of Publications, U. S. Coast and Geodetic Survey. This may be obtained without charge upon request to the Chief, Publications Division.

BUREAU OF FISHERIES

*Propagation and Distribution of Food Fishes, Fiscal Year 1928.* By Glen C. Leach. Bureau of Fisheries Document No. 1049. Price, 10 cents.

*Experiments in Marking Young Chinook Salmon on the Columbia River, 1916 to 1927.* By Willis H. Rich and Harlan B. Holmes. Document No. 1047. Price, 40 cents.

*Coregonid Fishes of the Great Lakes.* By Walter Koelz. Document No. 1048. Price, $1.10.

*Life History of the Lake Herring (Leucichthys artedi Le Sueur) of Lake Huron as Revealed by its Scales, with a Critique of the Scale Method.* By John Van Oosten, Ph.D. Document No. 1053. Price, 65 cents.

*Fisheries Service Bulletin.* Compiled monthly by the Bureau of Fisheries, and may be obtained from the Chief of Publications Division, without charge.

PANAMA CANAL

*The Panama Canal Record.* Compiled weekly. Subscription rates, domestic, 50 cents per year; foreign $1.00; address The Panama Canal Record, Balboa Heights, Canal Zone, or The Panama Canal, Washington, D. C.

BUREAU OF MINES

*Cadmium in 1927.* By Paul M. Tyler. No. I: 14. Price, 5 cents.

*Lead in 1927 (General Report). Mineral Resources of the United States, 1927, Part I (pp. 341–372).* By Lewis A. Smith. No. I: 15. Price, 10 cents.

*Use of a Type N Miners' Gas Mask.* By S. H. Katz and G. S. McCaa. Miners' Circular 32. Price, 10 cents.

*Asbestos in 1927. Mineral Resources of the United States, 1927, Part II (pp. 299–311).* By Oliver Bowles and B. H. Stoddard. No. II: 25. Price, 5 cents.

*Phosphate Rock in 1927. Mineral Resources of the United States, 1927, Part II (pp. 313–326).* No. II: 26. By B. L. Johnson. Price, 5 cents.

*Anthracite in 1927. Excerpt from Mineral Resources of the United States, 1927, Part II.* By O. E. Kiessling and H. L. Bennit. Price, 10 cents.

*Metallurgical Limestone. Problems in Production and Utilization.* By Oliver Bowles. Bulletin No. 299. Price, 10 cents.

*Terminology in Coal Research.* By Reinhardt Thiessen and Wilfrid Francis. Technical Paper 446. Price, 10 cents.

*Petroleum Refinery Statistics 1927.* By G. R. Hopkins. Bulletin 297. Price, 20 cents.

*Summarized Data of Zinc Production.* By Elmer W. Pehrson and The Common Metals Division. Economic Paper 2. Price, 15 cents.

*Historical Summary of Gold, Silver, Copper, Lead, and Zinc Produced in California, 1848 to 1926.* By James M. Hill. Economic Paper 3. Price, 5 cents.

BUREAU OF THE CENSUS

*Total Population by States, Counties, and Cities, 1920.*

*Record Book of Business Statistics. Part III. Fuels, Automobiles, and Rubber.* Price, 10 cents.

*Water Transportation 1926.* Price, 25 cents.

*Survey of Current Business, February, 1929, No. 90.* Subscription price, $1.50 a year; single monthly copies, 10 cents; semiannual issues, 25 cents.

*Survey of Current Business, March, 1929, No. 91.* Same price as above.

*Survey of Current Business, May, 1929, No. 93.* Same price as above.

*Mortality Statistics, 1926. Twenty-seventh Annual Report, Part I.* Price, $2.00 (Buckram).

U. S. DEPARTMENT OF AGRICULTURE

*Intermountain District Forest Statistics.* Compiled 1923.

HELEN M. STRONG.

SMITH, J. RUSSELL. *Tree Crops, A Permanent Agriculture.* xii and 333 pp., maps, charts, many illustrations, appendices, and index. Harcourt, Brace & Company, New York, 1929.

*Tree Crops* is an excellent book. It is a book with a sincere purpose, a real mission. It is a book of great educational value, of rich factual content, of convincing description and argument. It is a book of general interest and appeal, of reference importance, and of specialized application.

But it is much more than a book, an excellent book at that! It is the message of an inspired high priest of the cult of wise living, the fruit of his years of matured thinking, ripe judgment, and intimate counsel with seers and sages. It is the summons to a sounder use of our land, to a reclamation of our waste places, to a fuller appreciation of our potential resources. It is the sincere sermon of a man of deep convictions always courageously expressed and stoutly defended.

As a book it is well worth reading for pleasure and for profit; well worth placing on the shelves of every library for reference and inspiration; well worth putting into every home and every school for its wealth of information and new ideas. As a message from an inspired leader it is well worth heeding; well worth acting upon; well

worth being made a guide for places and programs of land use and reclamation.

In three brief introductory chapters—"The Problem," "The Idea," "The Plan"—J. Russell Smith sets forth his philosophy, his hopes for the conservation of waste and wasting lands, for prosperous people on steep slopes and rugged mountains, for more happiness and culture for us all. With characteristic directness he opens his argument in "The Problem" with a word picture of the desolation and destruction represented on the denuded slopes of over-populated China by which he indicates the possible future of Carolina, of Oklahoma, of Illinois, of all the fertile American farm lands if denudation, and erosion, and leaching be not checked. Then in "The Idea" he paints another vivid picture of the chestnut mantled hills of Corsica in contrast to the gully-gashed hills of China, to show how by planting tree crops on water-worn slopes America may save itself from the desolation and ruin of China, of Spain, of Syria, and achieve the beauty and security of Corsica. And finally in "The Plan" he outlines a constructive program to begin at once, a program of erosion surveys, of institutes of mountain agriculture, of search for profitable trees, of forestation in fruit and nut-producing trees on a grand scale.

Most of the rest of his book is devoted to "Some Facts about Some Crop Trees." This section is rich in information regarding possible tree crops in various sections of the country, their character, their use, their yield, their contribution to good living. The closing fourth of the book deals with the economics of tree-crop production, and its application to the farm, the nation, and the race.

The value of the book is enhanced by its clear illustrations, its exhaustive index, and its superior typographic makeup. It is so interesting, so useful, so valuable, that it should be one of the "best sellers."

W. ELMER EKBLAW.

COPELAND, D. B., Editor. *Australian Wool Annual*, Vol. 1, 1927–1928. 120 pp., 12 graphs and maps, 23 illustrations. Published Reviews Proprietary Limited, Melbourne. Distributed by Robertson & Mullens, 107–113 Elizabeth St., Melbourne. 9½ x 12 inches. Price, 17/6.

The *Wool Annual* contains a foreword and ten articles by authorities. It is beautifully printed on heavy paper and contains splendid pictures illustrative of the Australian wool industry.

In the year 1927–1928 Australian sheep numbered 99,200,000. The wool clip totaled 897,797,000 pounds, worth approximately 63,000,000 pounds. Exports of wool represented 62½ per cent of the total exports of primary industries.

The influences affecting wool prices are discussed by H. E. Teare. The editor describes the world supply and demand for wool, and the marketing of wool in Australia. He states that in 1925 sheep in the world numbered 573,655,000, a decrease of 11 per cent from pre-war figures. Wool production, however, declined only 6 per cent. Detailed tables give the wool production for countries of the world, which totaled 3,123,490,000 pounds in 1926. In that year, the four leading producers of wool, in pounds, were: Australia 830,460,000, Argentina 314,840,000, United States 310,901,000, and New Zealand 207,801,000, Australia producing as much as the next three countries combined.

The natural sheep belt lies between 10–30 inches of annual rainfall, comprising approximately 1,500,000 acres. Expanding agriculture may remove some land from pastoral use. Possible expansion of sheep stations into the Barkly Tableland of the Northern Territory, the Nullabor Plain north of the Great Australian Bight, and the southwest of Western Australia should allow the maintenance of the present number of sheep and perhaps allow expansion beyond 100,000,000 animals. The grazing capacity of pasture land is considered to be 4 per cent of the annual rainfall in inches. "In other words, 25 inches of rain are required to support a sheep to the acre."

Wool is marketed through brokers, numbering 63 firms in 1927, who arrange auction sales where most of the bales of wool are actually sold.

One of the most interesting sections of the book is "Life on an Australian Sheep Station," by W. M. Webb, based especially on a property covering 1,500 square miles and supporting about 220,000 sheep. The engaging of hands, handling of sheep, carting of wool, shearing methods, wool classing, etc., are fully described. The shearers are all union men and hire their own cook. "The Boss of the Board" is in charge of the shearing shed for the owner. The shearers select one of their number, called "The Rep.," to intervene when necessary between the union and the owner.

Australian sheep are nearly all of Merino stock, both pure-bred and cross-bred. The best breeding stock is eagerly sought after, and high prices are paid. In 1927, 5,000 guineas was twice paid for a ram, and pictures of the high priced sheep are included in the book.

The *Wool Annual* is a very useful publication, and should be consulted by all interested in Australia and the wool industry in general. However, it might be improved by the inclusion of an index.

OTIS W. FREEMAN.

KELLER, ALBERT GALLOWAY, and BISHOP, AVARD LONGLEY. *Commercial and Industrial Geography.* Revised edition. 357 pages; ills., index. Gerin and Company, Boston, 1928. $1.28.

This elementary textbook is organized around the three important economic activities, which satisfy man's need for food, clothing, and shelter.

Part I is more or less introductory, treating of the major industries of the world. In the first chapter the chief needs of man and how they are supplied are discussed, thus orienting the student in respect to the subject matter of commerce and industry. The next two chapters are devoted to the industrial regions of the world with the latter given over entirely to the United States. A fourth chapter, entitled "The Manufacture of Rubber Boots and Shoes," illustrates the selection of a sample industry in order that the important principles of commercial and industrial geography may be presented vividly and realistically to the student.

Part II, devoted to man's primary need for food, consists of four chapters, two on food materials, and two on the sample industries: the production and distribution of wheat, and the manufacture of flour.

Similarly, Part III includes two chapters on clothing with sections devoted to the several elements, physical, cultural, and others, which determine the character of wearing apparel. As a sample industry, cotton receives detailed study in two chapters, and the modern factory system with its characteristic division of labor makes the content of the last chapter.

Part IV, devoted to shelter, the last of the triumvirate of needs, consists of a chapter on the materials used in dwellings with illustrations chosen from among the diverse peoples of the earth. The final chapter of the book treats of the modern home of town and country, reviewing simply the evolution of the means of satisfying man's needs and wants in regards to his house and its furnishings.

For each chapter a set of thought-provoking questions is appended collectively at the end of the book. A fairly comprehensive index completes the structural plan of this text.

The teacher who scans this book, contemplating using it for a basic text, will be favorably impressed by the many suitable illustrations. The authors seem to have been guided by the principle of "a picture to the page" makes reading a pleasure. Certainly the content of the book justifies the title if we grant that a geography may be organized around the activities of man. But, the teacher who has kept abreast with the developments of modern geography will be disappointed that this book is a bit old-fashioned. This is graphically illustrated by the undated—but pre-Versailles—map of Germany on page 129. A map of Russia on page 148 carries boundaries which have been out of date for a decade. Elsewhere, the old illustrations have been retained thus depreciating the value of the text. If more recent photographs and maps had been used, the importance of this little book would have been greatly enhanced. It is unfortunate that the statement "revised edition" has not been abundantly justified.

GUY-HAROLD SMITH.

STAMP, L. DUDLEY. *An Intermediate Commercial Geography.* 778 pp.; ills. In two volumes: Part I, *Commodities and World Trade*, $2.75; Part II, *The Economic Geography of the Leading Countries*, $4.50. Longmans, Green and Co., Ltd., London, 1927–1928.

The author of these volumes has given to the English-speaking student of geography a clear and concise statement of the more important facts of world trade. This includes a treatment of the main commodities in making up the world's commerce, and the economic geography of the leading countries. His purpose, as the title indicates, is to bridge the gap between high school and university—between the child's text whose word is law and the man's text which may question, disprove, and even ridicule statements once thought above suspicion. For this reason references are simple and few, acquainting the student with a set of source-books at once important and easily accessible. For this reason, too, the work has not been made gazetteer-like in the effort to include everything regardless of its importance. Particularly in Part II some will question the wisdom of the omissions, but the author has made his selections and finds that they suit his purpose.

The chapter headings serve to show the inclusive nature of the first volume and the selections in the second.

PART I

Chapter
- I. Modern Geography
- II. The Structure of the Earth
- III. Climate and Weather
- IV. The Major Natural Regions of the World
- V. The Distribution and Activities of Man
- VI. Cereals
- VII. Other Vegetable Foodstuffs
- VIII. Meat, Dairy Produce, and Fish
- IX. The Raw Materials of the Textile Industries
- X. Other Raw Materials of Vegetable Origin
- XI. Power
- XII. Metals
- XIII. Inland Transport
- XIV. Ocean Transport

PART II

- XV. North America—Canada and United States
- XVI. South America—Argentine, Brazil, and Chile
- XVII. Africa—South Africa, Egypt and the Barbary States
- XVIII. Australia and New Zealand
- XIX. Asia—India, Further India, China, and Japan
- XX. Europe

Chapters I through V comprise the first ninety pages, presenting shortly, and yet with remarkable fullness, the essential facts of world geography on which are based the more detailed studies that follow. Each commodity is then considered with respect to conditions of its occurrence, its production in the world and in the chief countries, and its place in world trade. In Part II, after a general treatment of each continent, its major countries are fully portrayed in the light of their natural physical features and their industrial and commercial attainments. Besides this, some of the smaller countries are briefly summarized. In each chapter are, for the student, exercises in the form of keeping the graphs up to date, blanks having been left for that purpose, and questions taken from university and other examinations.

The text is concise, compact, to the point, delineating without frills the facts it has to set down. But, it is in the diagrams that lies the great attraction of these books. In their abundance and simplicity they make clear situations which in words may only confuse the student. In a work of 778 pages there are 555 black and white maps, diagrams, and graphs; and these are the only "pictures." So satisfying are they that they not only illustrate and interpret the text, but supplement it as well. Each map, in showing only one thing, allows the student to grasp the full significance of one fact before passing to another. The large number of such illustrations almost tells the story without the need of any text at all.

A world geography is this, containing a multitude of facts for reference—the most important facts—easy to get at through a good index and clear paragraph headings. This, combined with so many forceful and understandable maps, makes Mr. Stamp's contribution to the list of geographical textbooks one worthy of more than a passing notice.

PRISCILLA H. WEBSTER.

LITMAN, SIMON. *Essentials of International Trade.* Second revised and enlarged edition. xii and 380 pages. John Wiley & Sons, New York, 1927. $3.50.

The two aspects of international trade, the public and the private, are presented in turn. The first part deals with (1) the principles and theories of trade as set forth by their ablest proponents and opponents, for the most part without comment by the author, (2) each type of national intervention in commercial activities, and (3) the rôle of organized groups and government representatives in the promotion and transaction of our foreign trade. Two entire chapters devoted to the functions of the Department of Commerce and of the Consular service bespeak the importance of these two organizations.

Each principle of foreign trade is illustrated by one or more historical examples and is usually followed by an authority's estimate of its significance. Mention is made of the published reports of various government trade investigations, but as illustrations of the functions of the investigating bodies rather than as source material. These reports are not listed together for reference.

The fact that most of the problems of world trade are still matters of controversy is explained by the almost insuperable obstacles in the way of trade research. Some of these difficulties are: absence or gross inaccuracy of data on domestic commerce and exports, lack of uniform practice or units in weighing, measuring, and evaluating, and, until recently, antiquated tariff schedules. The chapter on "Market Analysis" holds a challenge for those who write from superficial observation or from only those data which are immediately available. For those who are to conduct investigation the chapter offers helpful suggestions.

Except for this chapter and the one following it on "Foreign Commercial Laws," the second part of the volume treats exclusively and exhaustively of the mechanics of foreign trade.

Classification of goods, intermediaries, exporting and importing agencies, market practices, advertising methods, credit and finance, and shipping facilities, help to make up the world trade picture. Into this are introduced interesting sidelights on the distorted importance of one or another of these factors resulting from geographic or other influences.

Although the author decries nationalism in international trade perhaps the more because of his background, in no other way are his European birth and education apparent. He studiously keeps his own opinions out of Part I of his text by the use of citations of authority. In Part II he evaluates methods and institutions, and offers advice.

The language of the book is straightforward, clear, and very readable. Ideas are expressed simply, without irrelevant embellishment, and so well organized that at no point does the reader lose sight of the central theme. Terms peculiar to commerce, used freely but always with adequate explanation, add to the value of the book. The author presents opposing views with entire impartiality on all moot questions.

The volume, so outstanding in nearly every respect, is, unfortunately, not well illustrated. The few charts, graphs, and tables that are used (there are thirteen in all), leave much to be desired. The interchanged captions on the pair of graphs on page 61 showing the trend of imports and exports are confusing, and the table on page 47 requires more study than it is worth. The better charts, such as that showing the organization of the Bureau of Foreign and Domestic Commerce, are from acknowledged sources. The reader has little difficulty in following the discussions except where reference is made to figures.

That the author is quite at home in the literature of the field is apparent from the extensive, well-selected reading lists at the end of each chapter.

Unbiased, comprehensive, authoritative, and very readable, it is a book that should be in every geographer's library.

MEREDITH F. BURRILL.

JONASSON, OLOF. *Ekonomisk Geografi med Varukännedom* (*Economic Geography and Science of Commodities*). 334 pp., 20 world maps, many charts and diagrams. A.-B. Hasse W. Tullbergs Förlag, Stockholm, 1929.

In this book for Swedish schools, Olof Jonasson blazes a new trail for high school and college geography, using as the basis of his presentation a study of commodities instead of a study of regions. It is not in the basis, but in the structure of fact upon this basis that he has achieved a new plan. For each commodity he treats the geographic relationships between the physical and economic factors and production, distribution, manufacture (if any) and consumption. World maps for more than twenty of the world's most important commodities, indicating production, routes of trade, and consumption are included with the text to illustrate graphically the essential details of the most important phases of economic geography. In addition numerous smaller maps, many charts and tables, and some pictures, help to elucidate the concise but comprehensive text.

To elaborate the titles of the several chapters of this excellent book would be too lengthy a discussion. Production, distribution, consumption, population, and land utilization are treated in general. Foodstuffs, beverages, textiles, rubber, oils and fats, timber, ores and metals, building stone, porcelain and glass, coal, petroleum, waterpower, and fertilizers are some of the commodities discussed item by item. A brief summary of Sweden's economic geography concludes the book, the point of view is naturally Swedish throughout, and the book is written in Swedish, though the author holds his Ph.D. in geography from an American University.

This valuable book deserves translation into English, but the cost would probably be prohibitive on account of the numerous maps which form so important a part of the material presented. If it could be produced in English in Sweden, and distributed in America without an onerous tariff charge against it, the book would sell at a reasonable price and win popular support; but to produce it in America would probably make the price too high.

W. ELMER EKBLAW.

## ANNOUNCEMENT

DR. CLARENCE F. JONES has recently returned from South America after having assembled authoritative data, and studied conditions in the field, for the completion of his series on the *Agricultural Regions of South America*. His series is continued in this issue.

Due to the difficulty of assembling and interpreting statistics for part of his regions, the next instalment of Dr. O. E. Baker's series on the *Agricultural Regions of North America* has been postponed until a later issue.

*Agricultural Regions of Africa*, by Homer L. Shantz of the University of Illinois and president-elect of the University of Arizona; *of Australia*, by Griffith Taylor of the University of Sidney, one of the foremost geographers of the world; and *of Asia*, by Olof Jonasson of the University of Commerce of Stockholm will follow in later issues to complete the finest geographic discussion of the world's agriculture thus far published.

To obtain the complete series of these extremely valuable articles, which present for the first time on such a comprehensive and accurate basis the significant divisions of the world's most important industry, it will be necessary to subscribe at once for ECONOMIC GEOGRAPHY, and date back to the October, 1926, issue.

In addition to this series of articles on agriculture, other series are being initiated; every issue will also contain four or five articles dealing with urban and regional geography, with problems of land utilization, with programs of development of resources, with commerce, with transportation, with health, and with the hundred and one other subjects that are of present geographic interest, all by the most competent and best informed authorities in their respective fields. ECONOMIC GEOGRAPHY is indispensable to the intelligent citizen.

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A QUARTERLY journal of ECONOMIC GEOGRAPHY published by Clark University for the benefit of geographers, economists, teachers, professional and business men, and all who are interested in the intelligent utilization of the world's resources.

Subscription rates are $5.00 the year in the United States and its Territories; $5.50 the year beyond the borders of the United States, except to charter subscribers.

Only a limited number of the first numbers of ECONOMIC GEOGRAPHY are available.

The April issue of Volume 5 contains the following articles:

*Agricultural Regions of South America*, Clarence F. Jones, Clark University.
*The Potash Industry of Europe*, Fred S. Mohme, University of Illinois.
*The Sugar Industry of the British West Indies and British Guiana with Special Reference to Trinidad*, C. Y. Shephard, Imperial College of Tropical Agriculture.
*Iron and Steel Industry of the Middlesbrough District*, John W. Frey, University of Wisconsin.
*The Grape Industry of Spain and Portugal*, W. O. Blanchard, University of Illinois, and Elizabeth R. Blanchard.
*The Philippine Lumber Industry*, Luis J. Borja.

January includes:

*Industrial China*, H. F. James, Wharton School of Finance and Commerce.
*Land Resource Inventory in Michigan*, Carleton P. Barnes, Michigan Land Economic Survey.
*Agricultural Regions of North America*, Oliver E. Baker, U. S. Dept. of Agriculture.
*Scranton's Industrial Integrity*, Clifford M. Zierer, University of California at Los Angeles.
*A Critical Situation in Two One-Crop Wheat Farming Districts in California*, John W. Coulter, University of Hawaii.

The October issue of Volume 4 contains the following articles:

*Fisheries of the South Atlantic and Gulf States*, J. H. Matthews, Atlantic Coast Fisheries Company.
*The Iron and Steel Industry of the Birmingham, Alabama, District*, Langdon White, Randolph-Macon Women's College.
*America's Resources in Nitrogen, Potash and Phosphorus*, Guy E. Mitchell, U. S. Geological Survey.
*Possibilities of Rubber Production in Caribbean America*, Jewell Venter, University of Missouri.
*The Kentucky Geographical Surveys: A Review*, W. Elmer Ekblaw, Clark University.
*Agricultural Regions of North America*, Oliver E. Baker, U. S. Dept. of Agriculture.

July includes:

*The Civilizing Rails*, Mark Jefferson, State Normal School, Ypsilanti, Michigan.
*Piedmont North Carolina and Textile Production*, Jefferson Bynum, University of North Carolina.
*Location Factors in the Iron and Steel Industry*, Richard Hartshorne, University of Minnesota.
*The Ozark Orchard Center of Southern Illinois*, Ina C. Robertson, State Teachers College, Valley City, North Dakota.
*Agricultural Regions of South America*, Clarence M. Jones, Clark University.
*Egypt is the Nile*, Paul F. Gemmill, University of Pennsylvania.

April includes:

*Iron and Steel Industry of the Pittsburgh District*, Langdon White, Miami University.
*European Forests and Their Utilization*, Bruno F. A. Dietrich, University of Breslau.
*Agricultural Regions of South America*, Clarence F. Jones, Clark University.
*Localization of the Cotton Industry in Lancashire, England*, Rollin S. Atwood, Clark University.
*New York Barge Canal—Expectations and Realizations*, Florence Whitbeck, University of Rochester.

January includes:

*Agricultural Region of South America*, Clarence F. Jones, Clark University.
*The Red Land of Gwent in Eastern Monmouthshire*, E. Muriel Poggi, University of Illinois.
*Agricultural Regions of North America*, Oliver E. Baker, U. S. Dept. of Agriculture.
*Cotton Manufacturing—North and South*, Robert M. Brown, Rhode Island College of Education.
*Distribution of Crops in Peru*, Harley P. Milstead, Montclair College of Education.

Single copies of back numbers of Volumes 1 and 2, 1925 and 1926, will be sent to any American address for $1.75 each; to any foreign address for $2.00. Back numbers of Volume 3, 1927, Volume 4, 1928, and Volume 5, 1929, will be sent to any American address for $1.50 each; to any foreign address for $1.75. Whole volumes may be obtained at the yearly rate.

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